TAMPERE UNIVERSITY OF TECHNOLOGY

OSKARI HELMINEN

THE ROLE OF ORDER CONTRACTS IN SHAREHOLDER VALUE CREATION

Master of Science Thesis

Prof. Saku Mäkinen and Assoc. Prof. Juho Kanniainen have been appointed as the examiners at the Council Meeting of the Faculty of Business and Technology Management on November 9th, 2011.

ABSTRACT

TAMPERE UNIVERSITY OF TECHNOLOGY
Master's Degree Programme in Industrial Engineering and Management

HELMINEN, OSKARI: The Role of Order Contracts in Shareholder Value Creation
Master of Science Thesis, 83 pages, 2 appendices (5 pages)
March 2012
Major: Industrial Management
Examiners: Professor Saku Mäkinen and Associate Professor Juho Kanniainen
Keywords: Event study, order contract, order contract announcement, project business, shareholder value, market reaction

This thesis uses event study method to examine the stock price reaction to announced order contracts. Although numerous event types have been studied with the method over several decades, order contract announcements are rarely analysed but still very important especially in project-based business. The research sample consists of two minerals and metals processing technology companies: Outotec Oyj and FLSmidth Co. A/S. Besides defining the general stock reaction to order contracts, the sources of cross-sectional variation are tested.

There are two main objectives in this research. The first one is to identify issues concerning the usage of event study method. This is particularly important because the sample size of two companies creates some methodological challenges. First objective is achieved by conducting a literature review of past researches in the field of event studies. Second objective is to define the general stock market reaction to announced order contracts and seek for explaining variables for cross-sectional variance. The variables that are tested in hypotheses are company net income percentage, order contract value, business area operating margin and inflation level. The hypothesis testing is done with regression analysis.

The results show that significant stock price reaction to order contract announcement is found on event day and it is positive as expected. Comparison between companies indicates that higher net income percentage yields higher positive stock price reaction. Order contract value is found to be explaining factor of abnormal return variance to one company and inflation level to the other company. For academics the research brings new information to company fundamental valuation and clears some methodological issues. For managers, the results imply that investors are well aware of order size expectations, so effective investor communication is essential. The abnormal return variance stays unexplained for the most part, meaning that non-systematic factors contribute highly to the stock reaction of order contract announcements.

TIIVISTELMÄ

TAMPEREEN TEKNILLINEN YLIOPISTO
Tuotantotalouden koulutusohjelma

HELMINEN, OSKARI: Tilaussopimusten julkistusten vaikutus osakkeenomistajien arvonluontiin
Diplomityö, 83 sivua, 2 liitettä (5 sivua)
Maaliskuu 2012
Pääaine: Teollisuustalous
Tarkastajat: professori Saku Mäkinen ja yliopistonlehtori Juho Kanniainen
Avainsanat: tapahtumatutkimus, tilaussopimus, tilaussopimuksen julkistus, projektiliiketoiminta, osakkeenomistajien arvo, markkinareaktio

Tässä työssä hyödynnetään tapahtumatutkimusmenetelmää selvittämään tilaussopimuksen julkistamisen vaikutusta osakekurssiin. Vaikka tapahtumatutkimuksia on tehty vuosikymmenten ajan lukuisista eri tapahtumatyypeistä, tilaussopimukset ovat hyvin harvoin tarkastelun kohteena, mutta silti erittäin tärkeitä etenkin projektivetoisessa liiketoiminnassa. Tutkimusotos sisältää kaksi metalli- ja mineraaliprosessointiteknologiayritystä, Outotec Oyj:n ja FLSmidth Co. A/S:n. Yleisen osakereaktion tutkimisen lisäksi tutkimuksessa testataan mahdollisia lähteitä osakereaktion varianssille.

Tutkimuksessa on kaksi päätavoitetta, joista ensimmäinen on tunnistaa tapahtumatutkimusmetodologian olennaisia piirteitä ja ongelmia. Tämä on erityisen tärkeää, koska pieni otoskoko aiheuttaa metodologisia haasteita. Ensimmäinen tutkimustavoite saavutetaan suorittamalla kirjallisuuskatsaus menneisiin tapahtumatutkimuksiin. Toinen tutkimustavoite on määrittää yleinen osakereaktio tilaussopimuksen julkistukseen ja etsiä selittäviä muuttujia reaktion eroihin otoksen sisällä. Testattavat muuttujat ovat yrityksen liiketulosprosentti, sopimuksen arvo, liiketoiminta-alueen käyttökateprosentti ja inflaatiotaso. Muodostetut hypoteesit testataan regressioanalyysilla.

Tulokset osoittavat, että hypoteesin mukainen positiivinen osakereaktio syntyy tapahtumapäivänä. Vertailu yritysten välillä tuo ilmi, että korkeampi liiketulosprosentti aiheuttaa suuremman reaktion. Tilauksen arvo on selittävä tekijä epänormaalien tuottojen varianssille toisessa yrityksessä, ja inflaatio toisessa. Liiketoimintatieteeseen tulokset tuovat uutta informaatiota perustavanlaatuiseen yritysvaluaatioon ja selventävät metodologisia ongelmia. Yrityksille tulokset implikoivat, että sijoittajilla on vahvoja odotuksia tulevien tilausten arvoista, joten tehokas sijoittajakommunikaatio on tärkeää. Epänormaalien tuottojen varianssista suurin osa jää selittämättä, joka tarkoittaa sitä, että ei-systemaattisten tekijöiden rooli vaikutuksen suuruudessa on merkittävä.

PREFACE

The working process of this thesis follows the usual story: the topic searched for its final form for various weeks or even months and was eventually a leap to a totally new area of business theory to me. If someone would have told me a year ago that I am going to use Matlab to calculate results in my Master's thesis, I would have said "No way!" and laughed. Luckily, my prejudice was wrong and getting sensible results from the tons of stock and event data was the most rewarding part of the whole process.

I owe great thanks to Professor Saku Mäkinen, who advised and guided me through the process, and to Associate Professor Juho Kanniainen, whose finance theory knowledge and Matlab support was essential in advancing this project. Also, I received many sharp comments regarding my thesis presentations from Innovadis project team (including Marko Seppänen, Asmo Vartiainen, Jani Saarinen, Juhani Kyytsönen, Eeva Laine and many more) that challenged me to rethink many aspects of the study.

A valuable source of feedback was also my peer group of thesis workers, Joonas Olkkonen, Johannes Mamia and Pasi Kuparinen, who offered good advice and helped me with the occasional bursts of frustration. Lastly, thanks to all my friends and family who have supported me all the way.

Helsinki, 24th of February

Oskari Helminen

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ABBREVIATIONS AND NOTATION

AR	Abnormal return
b	Fraction of income a company is expected to retain
b_j	Correlation coefficient of stock j
D	Fraction of income divided to shareholders
$E(R\|X)$	Expected normal return R with conditioning information X
g	Expected dividend growth rate
J_2	P-value of standardized cumulative abnormal return
k	Required rate of return/profit
P	Stock price
R	Actual perceived rate of return
r	Rate of return/profit
r_{arith}	Arithmetic return rate
r_f	Risk free rate of return
r_{log}	Logarithmic (or continuously compounded) return
r_m	Market risk rate
V_f	Final value of an investment
V_i	Initial value of an investment
W	Wilcoxon W-value
Y	Expected income
α	Intercept term in regression model
β	Beta (or correlation or market sensitivity) coefficient

ε	Error term
ζ	Disturbance term
$\boldsymbol{\theta}$	Estimation parameter vector
μ	Mean return rate
σ	Standard deviation
λ_0	Riskless rate of return
λ_n	Systematic factor
ANOVA	Analysis of variance
APT	Arbitrage pricing theory
CAPM	Capital asset pricing model
CRSP	Center for Research in Security Prices
CSR	Corporate social responsibility
EAFE	Europe, Australia, Far East index
EBIT	Earnings before interest and taxes
ELE	Energy, light metals and environmental solutions
FTSE	Financial Times Stock Exchange
GNP	Gross national product
OLS	Ordinary least squares method
OMXC	OMX Nordic Copenhagen Stock Exchange
OMXH	OMX Nordic Helsinki Stock Exchange
P/E-ratio	Price per earnings ratio
R^2	Coefficient of determination
SCAR	Standardized cumulative abnormal return
SIMM	Single-index market model

1. INTRODUCTION

For many companies getting valuable order contracts to fill the order backlog is the lifeline of their whole business. Without orders there is no revenue and without revenue there can be no profits. In project-based business rational investors are seeking to invest their money into a company that displays high profits with a solid order book to get a good and sustainable return to their investment. Winning profitable orders is crucial in this game, so the relation of investor sentiment and outdoing competitors in valuable order contracts is highly relevant subject in the field of business and financing.

From the academic perspective it is interesting to know if the widely acknowledged market hypotheses apply to the event type of order contract announcements which is the core of contract-driven business, or is the essentiality of order contracts valued to stock price from other financial indicators such as quarterly value of order backlog. Also, the existence of the reaction indicates if the order contract announcements really are new information to the market or is the information leaked before the announcement. Unintentional information leakage is possibly valuable information to sample companies. Other useful aspect from the company perspective is the knowledge of their investors' rationality regarding order contracts: the company probably knows at least roughly how much profit a specific order generates, so comparing the actual profit to the change in market capitalization can indicate if companies successfully communicate the scale of their business activity to investors, and if some of their order contract announcements are overvalued or undervalued in the eyes of their investors.

From the investor perspective event studies in general give important insight on how stock reacts to certain events, and that insight can be used to explore new profitable investment strategies. In many occasions event studies explain the time frame where abnormal returns are possible to generate, and thereby giving a straightforward investment recommendation. Of course, if markets find out about a systematical abnormal return, the phenomenon should disappear when investors change their behavior according to the new knowledge. In this study the amount and timing of abnormal return is examined, thus a so-called free lunch opportunity for investors is a possible result. At minimum, the results of this thesis allow investors of the two sample companies to get a better idea of how to adjust their investment strategy regarding order contract announcements.

In this particular study two sample companies are selected because it serves the needs of the background project behind this thesis. Although the small sample size creates methodological challenges and reduces generalizability, the unorthodox sample also

allows testing event study methodology in a different setting. This case-like approach is rarely seen in event studies, so one main aim is to explore how event study method can be applied to create company-specific results.

1.1. Research objectives

Although the event study methodology has a long history and a vast amount of different events have been studied, the area of order contracts in shareholder value creation is still quite untouched. At first, the relation of order contracts to company success seems self-evident, but if the event is probed more thoroughly, the area can bring new insight on how shareholders respond to the main business activity of the case companies. The main research question of this thesis is:

How do investors react to announced order contracts?

To answer the question, the objectives of this thesis contain multiple aspects of event studies. Following the event study categorization of Bowman (1983) and Henderson (1990) this study is partly a *methodology study* with its purpose in defining an appropriate event study methodology that fits the other details of the research design to achieve robust results. The objective for the methodological research comes from the needs of the background project, where the methodological findings of this thesis are later applied to study other types of events. The research objective arising from the methodological part of event studies is:

O1: Identify the key elements and issues of event study methodology.

To reach the objective a review of past event study literature is done to identify the research design issues and to assess the suitability of various elements to this type of event study. Even after decades there is no standard set of methods to conduct event studies and the usage of different variables and statistical measures depends on other research elements. Therefore a methodological review is justified and valuable.

This study is also an *information usefulness study* aiming to assess the general price reaction of order contracts to selected company stocks. The analysis of information usefulness of the order contracts begins from the basic market efficiency hypothesis, continuing to explain smaller constituents to rationalize the investor reaction to the events of case companies. The research objective for the information usefulness is:

O2: Define the general stock market reaction to announced order contracts.

To approach the objective, the stock price reactions of order contracts awarded to two minerals and metals processing technology companies, Outotec Oyj and FLSmidth Co. A/S between 2006 and 2010, are researched with event study methodology, which is defined by answering the first research objective. The aim is to characterize a general

investor reaction to find out if announcements of order contracts are meaningful to investors. Lastly this study is a *metric explanation study* seeking to find deeper explanation to possible cross-sectional differences in stock market reaction. The study is not aiming to build a model to explain the variance itself, but seeking for variables that would lower the variance in results. Obviously, if the outcome of the second research objective is that stock markets do not generally react to order contracts at all, the latter questions are not quite relevant. It has to be noted though, that even if the general reaction is not found, some subsamples may indicate a reaction so more detailed research is in any case necessary. Therefore, the sub-objectives of the second objective are:

> *O2a: Does the reaction differ between the two sample companies and if so, are there specific characteristics that explain the difference?*
>
> *O2b: Can sample companies express and do investors perceive the implicit details of order contracts in their reaction?*

Objective 2a is approached by analyzing the characteristics of the companies, for example financial and operational key figures, corporate structures and announcement policies, and then reflecting the characteristics to event study results of firm-specific aggregate of events. Objective 2b is achieved by identifying economically significant factors that are related to order contracts, rationalizing the reaction to these factors to form hypotheses and finally testing the hypotheses with relevant cross-sectional aggregates of the events.

1.2. Research approach and methodology

The research approach for this thesis is a classical deductive approach (Saunders et al. 2009, pp.124-125). Based on existent literature in the field of finance, econometrics and management, hypotheses are deduced from the theory. After deducing general hypotheses, they are formulated in a way that the concepts or variables in them can be measured using econometrical methodology. Econometrical study involves applying statistical methods to the analysis of an economic phenomenon (Kennedy 2003, p.1), and in this study the method is an established statistical method searching for the stock price reaction around a corporate event, i.e. the event study method. The operational hypotheses are tested with the method and based on the results the suggested theory is either confirmed or rejected. In this particular research five hypotheses are built, and they all contribute to the same theoretical area of order contract announcement reaction. Usually, a rejected theory is modified to be re-tested again to verify it. However, in this thesis the five hypotheses build a hierarchical structure of the underlying theory, so rejecting some of the hypotheses does not imply a full revision of the theory, but instead the result can be a combination of verified and rejected hypotheses.

In the event study method statistical models are applied to reach the research objectives. The statistical foundation is a linear regression model of the data, where ordinary least squares (OLS) method is used to estimate the unknown parameters needed to calculate abnormal stock returns (McWilliams & Siegel 1997). In the econometrical methodology markets are assumed to be at least partially stochastic, and the stochastic element is captured in disturbance term ε (Kennedy 2003, p.3). To explain it simply: when the estimated abnormal return is compared to the estimated size of disturbance term, the power of hypothesis is tested to reach the objective of hypothesis acceptance or rejection.

The data in this research is multi-dimensional observational data gathered from external public sources. The raw stock data is collected from stock exchange database and the identified event dates with additional dimensions are collected from the sample companies' public stock announcement database. These two datasets are combined to enable relating the changes in stock price to the events and the event parameters. Even though some of the event details are not numerical, they are converted to be treated quantitatively. The research is purely quantitative, all the data is available freely and the methodology is aimed to be highly structured, thus the replication of the study is possible ensuring a high level of reliability (Saunders et al. 2009, p.125)

The purpose of this research, according to the classification of Saunders et al. (2009, pp.138-141), is not unambiguously identified, but rather a mixture of descriptive, explanatory and exploratory purposes. The descriptive part of the thesis is aiming to describe the event study methodology and the general existence of stock price reaction to order contract announcements. The explanatory elements are visible in the more detailed research objectives, which seek to explain the relationship between event variable and stock price reaction. The exploratory side of the study includes the unorthodox elements of event study research design such as the limited number of sample companies. Thus, this research is exploring to use the event study method in an unusual way.

1.3. Structure of the thesis

The introduction of the thesis presents the research question, research objectives, and the general research approach and methodology. Introduction is followed by two chapters of literature review, dividing the theoretical background into the justification of financial reaction to order contracts and into the description of methodological variation in event studies. The justification of financial reaction starts from introducing the event study methodology and the efficient market hypothesis that enables the usage of event study methods. The financial reaction is derived step by step from the basic stock valuation principles created over 50 years ago, advancing to valuating future earnings and eventually single order contracts. After presenting the theory explaining stock price

reaction and its cross-sectional variation, five hypotheses are built based on the theoretical findings and these hypothesis end the second chapter.

Chapter 3 continues the literature review by evaluating the methodological details and options of event studies. The research design under examination contains selection of sample companies and events, choosing length of event window, controlling confounding events, choosing calculation method of abnormal returns and reporting relevant test statistics. Different approaches for these details are compared based on experiences in earlier event studies. The methodology of the study is not selected in this point; instead methodology is analyzed in a general manner.

The fourth chapter introduces the case companies in a more detailed way and elaborates research methodology. Methodology choices are based on findings of previous chapter. Especially abnormal return calculation method and analysis of statistical significance is presented in an accurate manner to ensure the replicability of the study. After the research method and material is discussed, the fifth chapter includes the results of hypotheses testing. Hypotheses are tested one by one and the numerical results are supplied with brief verbal analysis. Following hypotheses testing, results are interpreted in a wider context, sensitivity of the results is investigated and error sources are analyzed. The fifth chapter ends with discussion and evaluation of the research, including reliability and validity analysis. The thesis is concluded in sixth chapter with a summary of research implications, limitations of the study and possible further subjects of research in this field.

2. FINANCIAL RESPONSE TO ORDER CONTRACTS

2.1. Basics of event study methodology

To approach the multifold and broad research method of event studies it is useful to start by collecting some basic definitions to this method. The originator of event studies, as they are essentially known also today, is a study by Fama et al. (1969) which did not yet use the term event study. The study aimed to "…examine the process by which common stock prices adjust to the information (if any) that is implicit in a stock split" (Fama et al. 1969, p.1). In other words, it was an event study concentrating on stock splits. By 1980 the term event study had been established and the following description of event study was given:

> "A major concern in those 'event' studies has been to assess the extent to which security returns were different from those which would have been appropriate, given the model determining equilibrium expected returns" (Brown & Warner 1980, p.205)

The definitions have been quite similar ever since with slight emphasis on different aspects of event studies: "Using this method, a researcher determines whether there is an 'abnormal' stock price effect associated with an unanticipated event." (McWilliams & Siegel 1997, p.626) "Using financial market data, an event study measures the impact of a specific event on the value of a firm." (MacKinlay 1997, p.13) "Event studies examine the behavior of firms' stock prices around corporate events." (Kothari & Warner 2007, p.5)

It is good to notice that although this thesis and the previous definitions concentrate particularly on stock price effects of events, event study can measure other effects as well. For example the effect of an event on stock trading volume (Campbell & Wasley 1996), operating performance (Barber & Lyon 1996) and stock return variance (Patell 1976) have also been examined. The stock price effect is still by far the most common approach. From the aforementioned definitions we can identify some key elements that must be considered when conducting an event study:

1. The events must be unanticipated.
2. The events must have an economic effect on the company.
3. The effect of an event is based on comparison between actual returns and "appropriate" returns.

4. The time window of the effect of an event is not unambiguously defined but "around" corporate events.

In the decades after the pioneering researches this methodology has been modified and developed to meet the above conditions more precisely as well as to utilize the increasing amount of data that is available from the stock markets. One huge change has indeed been the digital revolution enabling higher resolution of stock data that has improved the accuracy of event studies. During 1970s event studies used monthly data (Brown & Warner 1980), but after the same authors (Brown & Warner 1985) paved the way by solving some critical methodological issues, the usage of daily data started to increase. During 1980s the first intraday data sets were also utilized to research how fast stock markets actually react (Jennings & Starks 1985; Barclay & Litzenberger 1988). When the cost of computing power constantly decreased, 1990s saw the rise of electronic trading and especially high-frequency trading: a computer-driven trading characterized by a high number of trades but a low average gain per trade (Aldridge 2009, p.1). Between 2001 and 2008 electronic trading grew from 25 percent to 85 percent (Aldridge 2009, p.9) and between 2005 and 2009 the overall trading volume grew 164 percent (Duhigg 2009). The reaction time to new events has reduced to fraction of seconds with the help of ultra-low latency machine readable news that can be routed straight to trading systems without human interaction (Thomson Reuters 2011). As the pace of the stock markets accelerates, the event study methodology has had to match the speed thus some recent studies have been focusing on time frames of seconds or minutes to capture the event effects (Busse & Green 2002; Antunovich & Sarkar 2006). The adaptation to hectic trading rhythm is just one of the changes in event study procedure during its forty years of existence.

Although the general procedure of conducting event studies has been rather similar since 1970s, multiple variations of the details of an event study procedure can be found from the literature and no set of details is considered to be over others. Event studies can be categorized into four different types (Bowman 1983; Henderson 1990). *Market efficiency studies* are testing the validity of market efficiency assumptions, in other words how fast and accurately market reacts to new information. They do not usually contribute to management theory, but they are seeking to explore basic mechanisms or systematical pricing errors in financial markets. On the contrary, *information usefulness* or *information content studies* can carry managerial implications, as they evaluate the level of which abnormal returns occur when a particular type of information is released to markets. Another type of event study is called *metric explanation* in which abnormal returns are further analyzed with cross-sectional regression to assess which factors contribute to the perceived abnormal returns. This kind of studies can result in highly applicable results to the field of management literature. Lastly, an event study can be *model evaluation* or *methodological study*. The aim of those is to evaluate the methodological issues, such as research design, of event studies to gain better understanding and to improve the methodology in general. In methodological studies

different approaches are usually simulated to investigate what kind of results they produce. These four basic types of event studies are not mutually exclusive so it is possible to combine different approaches. For example in a same research there could be some new research design recommendations, a verification of market efficiency on a particular event and finally cross-sectional analysis of the abnormal returns.

There are a handful of seminal methodological articles widely cited in event study literature and the methodological contribution of those articles is also significant in this thesis. Bowman (1983) identified five steps in the event study procedure: 1) identifying the event of interest 2) modeling the security price reaction 3) estimating the excess returns 4) organizing and grouping excess returns 5) analyzing the results. Seven years later Henderson (1990) formulated a similar five-step procedure but with a slightly more detailed definitions of the steps: "1) define the date upon which the market would have received the news 2) characterize the returns of the individual companies in the absence of this news 3) measure the difference between observed returns and "no-news" returns for each firm – the abnormal returns 4) aggregate the abnormal returns across firms and across time 5) statistically test the aggregated returns to determine whether the abnormal returns are significant and, if so, for how long". Again, seven years later McWilliams & Siegel (1997) sharpened the methodology by compiling some of the theoretical advances made during the years. They are especially concerned about research design and implementation issues of event studies that deteriorate validity of results. In the research, three past event studies are replicated using their perception of methodological rigor discovering highly deviating results and practically nullifying the hypotheses supported in the original researches. They emphasize that their goal is not to invalidate the whole event study method in management research but to point out issues that weaken the credibility of the method. To avoid the pitfalls, a ten-step event study implementation guide was outlined:

> **"Step 1:** Define an event that provides new information to the market.
>
> **Step 2:**Outline a theory that justifies a financial response to this new information.
>
> **Step 3:**Identify a set of firms that experience this event and the event dates.
>
> **Step 4:**Choose an appropriate event window and justify its length, if it exceeds two days.
>
> **Step 5:**Eliminate or adjust for firms that experience other relevant events during the event window.
>
> **Step 6:** Compute abnormal returns during the event window and test their significance.

> **Step 7:**Report the percentage of negative returns and the binomial Z or Wilcoxon test statistic.
>
> **Step 8:**For small samples, use bootstrap methods and discuss the impact of outliers.
>
> **Step 9:**Outline a theory that explains the cross-sectional variation in abnormal returns and test this theory econometrically.
>
> **Step 10:** Report firm names and event dates in data appendix."
>
> (McWilliams & Siegel 1997, p.652)

Compared to previously mentioned procedure lists the list by McWilliams and Siegel (1997) is more detailed, naming some specific methods that should be used during an event study. Doubling the amount of steps also structures the different stages better and effectively includes all the steps presented by Bowman (1983) and Henderson (1990). However, some definitions of the steps still leave a lot of room for interpretation. Thus in the following chapters, the steps proposed by McWilliams and Siegel (1997) are discussed one by one reflecting the content to financial market principles and to the vast amount of literature regarding event studies.

2.2. Efficient market hypothesis and investor reaction

The first step of event studies is to define an event that is providing new information to market. First of all, there are some fundamental principles how stock markets or financial markets act to information or in a wider sense what is the role of information in stock markets. Starting from the 1970s it has been widely studied if markets are efficient, ie. if they "fully reflect" available information (Fama 1970). Jensen (1978) suggests a simple way of expressing market efficiency:

> "A market is efficient with the respect to information set θ_t if it is impossible to make economic profits by trading on the basis of information set θ_t." (Jensen 1978, p.3)

In addition to this simple expression of market efficiency Fama (1970) has constructed three forms of market efficiency to better capture the intricate details of financial markets:

> 1. *Weak form* states that stock prices fully reflect all past public information. Therefore it is not possible to predict future stock prices based on past prices (or returns).
>
> 2. *Semi-strong form* states that stock prices instantly change to reflect new publicly available information. Based on this efficiency form it is not possible to

benefit from new information even shortly after the information is released, because the information is already valuated to the stock price.

3. *Strong form* states that stock prices do not reflect only available public information, but any information relevant for the stock. Therefore it is not possible to benefit from insider information that is yet to be released to the public.

The validity of these three forms has been tested with many methods. Random walk tests and distributional tests of stock prices and returns have given strong support for the weak form of market efficiency. (Fama 1965; Fama 1970) Later on the weak form tests have been broadened to measure market efficiency in stock markets around the world, individually and cointegratively (Urrutia 1995; Chan et al. 1997; Olowe 1999; Cheung & Coutts 2001). The studies have shown that individual stock markets are, regardless of location and the volume of trading, efficient in the weak form. On the other hand, the cointegration of all the stock markets to a one efficient market hasn't had compelling evidence (Chan et al. 1997; Bekaert et al. 2009) so the global market as a whole is not fully efficient even in the weak form.

Semi-strong form of market efficiency is tested by measuring the lag in correlation between an event and the stock price. Barclay & Litzenberger (1988) found out that stock reacts mostly during the first 15 minutes following an announcement, but the full price adaptation takes at least three hours. Because of the rise of global information technology, the time needed for price adaptation has gradually become faster. Busse & Green (2002) measured the effect of CNBC on-air stock reports and concluded that significant returns can be made by trading within 15 seconds of a positive stock mention. When a stock is mentioned negatively, stock falls for 15 minutes. Longer timescale is possibly because of the higher expenses of gaining profits with a price drop. Therefore, contradictory to the semi-strong efficiency hypothesis, the effect is not instant so there are always some investors who can profit from the publishing of new information. Anyhow, this lag is getting shorter and shorter when trading technology and information distribution advances and already when examining stock markets on an hourly level the markets can be said to be efficient in semi-strong form.

The tests of strong form market efficiency concentrate on searching for investors who can "beat the market" with their professional or insider information. Seminal article made by Jensen (1968) about investing professionals analyzed the performance of 115 mutual fund managers. The conclusion was that professional investors cannot outperform buy-the-market-and-hold strategy individually or on average which means that strong form is valid at least for professional investors. Collecting evidence from various past researches Fama (1991) argues that professional portfolio managers can beat the market marginally but the margin is drained by the costs that information gathering and trading requires. On the contrary, insider information as a source of

significant abnormal returns has had strong evidence over time. A research performed in mid-70s about profitability of insider information showed 2 to 3 percent abnormal returns over 8 month period (Jaffe 1974), but the business environment and the insider trading regulations have been tightened substantially around the world since those days (Bhattacharya & Daouk 2002). In many countries stock exchange rules, regulations or laws require that companies must notify any major information concerning their stocks to the stock exchange without delays so insider information could not be exploited.

Besides illegal usage of insider information, there is also the notion of legal insider trading. Legal insider trading refers to trading done by insiders and informed to stock exchange according to local trading laws or regulations. Instead of contributing against strong form of market efficiency, legal insider trading has been seen even as a contributor to market efficiency (Aktas et al. 2008), but there are still many researches which conclude that insiders profit from their information days before news release (Betzer & Theissen 2009; Acharya & Johnson 2010). Insider trading regulations are clearly not strict enough to turn insider trading into efficient market information thus the strong from of market efficiency is not valid in today's markets.

The scholarly support for market efficiency in weak and semi-strong forms leads to the conclusion that event studies in financial markets are possible as market reacts to new information in a certain short time frame. The evidence against strong form of market efficiency means that the time frame is not around the actual event – instead it is around the moment when information about the event is made public. Insiders could profit from their insider information between the actual event and the publication of the event, but insider trading regulations are aiming to block these "unfair" profits. This information asymmetry also creates a problem of information leakage. For example, if a company internally decides to close a plant but doesn't announce it until months after the decision, there is a risk that information is gradually leaked to a bigger circle of people and better informed investors can valuate the event to stock price before the event is made public. In general, the events must be chosen in a way that possible information leakage is minimized.

2.3. Stock valuation principles

The second step in the event study procedure list is outlining a theory that justifies a financial response to the event, in this case announcement of signed order contract. For better understanding what is actually measured with stock price event studies, it is essential to specify what underlying elements the stock price of a company is incorporating. There are two somewhat different approaches to valuing stocks: first one is based on discounted growing cash flows that a certain stock creates to its owner (Gordon 1959) and second one is based on efficient arbitrage-free markets, where capital asset portfolios with equal risk and profit properties should have the same price

(Roll & Ross 1980). The second approach also discounts the future cash flows, but it emphasizes the role of calculating discount rate instead of the cash flow growth rate.

Gordon (1959) formulated the question to the first approach as follows: "…what an investor pays for when he acquires a share of common stock … (1) both the dividends and the earnings, (2) the dividends, and (3) the earnings". The empirical results support stock valuation theory in which an investor pays for the dividends by equation

$$P_0 = \frac{1-b}{k-br} Y_0 \tag{1}$$

where P_0 is the stock price at t=0, b the fraction of income the company is expected to retain and invest, r the rate of profit it is expected to earn on investment, k the required rate of profit, and Y_0 the expected income at year t=0. To simplify, br can be denoted as the expected dividend growth rate g and $(1-b)Y_0$ is the fraction of income divided to shareholders at year t=1 (D_1) so the equation becomes

$$P_0 = \frac{D_1}{k-g} \tag{2}$$

From this equation it is straightforward to see that price of stock depends on the amount of dividends, the required rate of profit, and the expected dividend growth rate. However, the equation poses some problems for stock valuation for example with a stock that does not pay dividends at the moment. In that case, D_1 would be 0 and if there are expected dividends in the future, the growth rate g must be infinite. To overcome these problems it was later argued that dividend policy is actually irrelevant in valuing stocks (Miller & Modigliani 1961). Dividend policy is rather just another side of investment policy, and combined they are the earnings of the company. Therefore, dividend per share can be, with certain limitations, substituted with earnings per share in stock valuation calculations. This approach to stock valuation clearly shows how the success of a stock in terms of earnings influences the stock price, but it doesn't show the complex linkage to financial markets in general.

The second approach to stock valuation, arbitrage pricing theory (APT), brings out the influence of macro-environment. According to APT, the stock price and return correlates with multiple systematic factors at some stock-specific sensitivity level. If markets are fully efficient, the factors and their sensitivities form market equilibrium where there are no arbitrage possibilities from undervalued or overvalued stocks. APT states that the expected return of stock j is

$$E(r_j) = \lambda_0 + \lambda_1 b_{j1} + \cdots + \lambda_i b_{ji} \tag{3}$$

where λ_0 is the riskless rate of return, λ_1, …, λ_k are systematic factors (loadings), and b_{j1}, …, b_{ji} are correlation coefficients (betas) of stock j. (Roll & Ross 1980) The influence

of different factors have been researched since APT model was introduced, and strong support in multiple countries has been found for macroeconomic variables such as the spread in interest rates, inflation, industrial production, oil price fluctuation, exchange rates and income per capita (Chen et al. 1986; Butt et al. 2010; Oskenbayev et al. 2011). There is no standard set of variables that is used with APT, but it is rather a theoretical tool of understanding stock prices and the macroeconomic market equilibrium. After the expected return for a stock at the end of a specific period has been calculated with APT model, the actual stock price can be discounted with the rate that the model implies.

Capital asset pricing model (CAPM) is another pricing model, that can be seen as a special case of APT, although CAPM was initiated a few years before APT. Sharpe (1964), Lintner (1965) and Mossin (1966) all independently researched the market equilibrium and the pricing of risky assets and came to very similar conclusion about capital asset pricing model. According to CAPM, the expected return of a stock *i* consists of two elements: risk free rate of return (r_f) and stock-specific risk premium. Stock-specific risk premium correlates with market risk premium ($r_m - r_f$) according to beta (β_i) coefficient:

$$E(r_i) = r_f + \beta_i(r_m - r_f) \qquad (4)$$

As it is easy to see, CAPM is basically APT with only one systematic factor: market risk premium. CAPM theory validity has many strong assumptions such as investors needing to have the same opinions about future asset values, they are rational, risk-aversive and broadly diversified with ability to take a long or short position of any size in any stock without transaction costs (Black 1972). Stock price is then discounted for a specific period with the rate that CAPM model implies. Regardless of the limitations CAPM is widely used for stock price valuation because of its relative simplicity to APT combined with results that are close enough to reality.

CAPM was later found to be insufficient in explaining stock returns in some situations. To improve the explaining power of CAPM, Fama & French (1992) added two more company specific factors to the model to describe the stock returns: market capitalization and book-to-market ratio[1]. The factors are derived from an observation that companies with low market capitalization or high book-to-market ratio (also known as value stocks) systematically tend to perform better. The significance of these factors change over time, therefore the latest calculated values can be found on French's website (French 2011). In a big dimensional study with 425 billion dollar total assets under examination, single-factor CAPM explained 70% of the stock return variability and three-factor CAPM reached the explaining power of 96% (IFA 2011). Although explaining power of single factor CAPM is already on a high level, three-factor CAPM is significantly more accurate in explaining stock returns.

[1] Book-to-market ratio = Company's total assets divided by company's market capitalization

To summarize the presented stock valuation principles, the first mentioned stock valuation, earnings approach, is deriving from the own actions of the company in relation to competitors and macro-environment while the latter models, APT and CAPM, link the stock valuation to general market movements or other systemic factors. Both approaches are useful in rationalizing the use of event studies for valuation of order contracts, because the orders straightforwardly influence company's earnings but on the other hand the stock price is highly tied to factors that simultaneously influence other stocks too. These views are therefore used hand in hand during this research.

2.4. Orders as a contributing factor to company earnings

So far it has been discussed how investors valuate dividends and earnings to stock prices, but the link to from total earnings to single orders is still to be clarified to reach the objective of justifying a financial response to order contract announcements. Besides the stock valuation approaches demonstrated earlier, the stock price movements can also be seen as an aggregate of changing company specific financial variables also called fundamentals. These fundamentals include for example inventory, R&D expenditure, labor force and order backlog. (Lev & Thiagarajan 1993) The search for fundamentals has continued for decades, but no standard set of fundamentals can be identified because they are in many cases industry specific or even company specific.

When a fundamental can be used to forecast the future success of a company, it is called a leading indicator. Leading indicators are not necessarily financial measures, but a wide range of figures describing company's actions. Order backlog is generally seen as a leading indicator for the earnings of the following period, usually year (Lev & Thiagarajan 1993; Rajgopal et al. 2003). Other researches of leading indicators have included for example sulfur dioxide emissions (Hughes 2000), customer satisfaction (Ittner & Larcker 1998) and number of patents (Deng et al. 1999). A good example of the explaining power of untraditional nonfinancial leading indicators is a study by Amir and Lev (1996) where the market values of cellular companies were compared to traditional financial figures (such as earnings and cash flows) and to nonfinancial indicators (such as the population of cellular service area and the market penetration). In the study the nonfinancial indicators had higher value-relevance than traditional financial indicators which clearly shows the ability of investors to value a wide scale of indirect factors contributing to company success.

Investors do consider order backlog as a leading indicator, but how strong is the effect of backlog as an indicator? A study by Rajgopal et al. (2003) investigated if stock market fully appreciates leading indicators of future earnings. Order backlog was selected as the leading indicator under analysis because its definition is quite standardized, it is widely disclosed, dollar denominated and cross-sectionally comparable across many industries. The sample data was very broad, representing 3170 firms with almost 22 000 firm-year observations of order backlog. The results showed

that order backlog is definitely a contributing factor to stock valuation. In fact, the research indicates that the investors are overly optimistic about order backlog if compared to cross-sectional association between order backlog and future earnings. The reason for over-valuing order backlogs is further probed in the article, and one potential explanation could be that equity analysts include backlog information in their earnings forecasts, but investors still value backlogs on top of analyst forecasts. Therefore the backlog is counted twice by many investors and the role of order backlog becomes exaggerated.

The contribution of order backlog to stock valuation is explicit, but the relation can be explained more thoroughly. In addition to finding twelve fundamental factors Lev & Thiagarajan (1993) conditioned the factors on macroeconomic variables aiming to find different emphasis of the factors depending on the macroeconomic situation. Three variables were used: inflation rate, annual GNP (gross national product) change and annual change in the level of business inventories (all figures are from USA). Order backlog is valued as expected: during times of high inflation order backlog includes a strong inflationary component which lowers the future real sales growth and diminishes the value of order backlog. Vice versa, the same size of order backlog during low-inflation years gives a stronger signal of real future performance, when inflationary component is not lowering the expected future profits. Differences in GNP growth did not show any relation to the signaling strength of order backlog. Interestingly, high inventory growth years showed higher appreciation of order backlog than low inventory growth years. Authors speculate the effect by stating that during high inventory growth years investors expect more future business and if the company fails to achieve it, negative reaction is stronger than during low inventory growth years.

One more step associating stock reaction to company earnings and stock reaction to single orders is the link between company's order backlog and winning single orders. Rather surprisingly, only one event study about winning order contracts was found in broad literature review. Alexander (1993) used five cases of major contract awards in defense industry to examine the leakage of insider information. Despite some methodological weaknesses, for example uncontrolled confounding events, the study shows significant abnormal returns (even 58,3%) after or before order contract is announced. It has to be noted though, that the role of examined orders for the focal defense technology companies was also huge, contributing 20-45 percent of their yearly revenue. The order contracts in this research are not so influential to the companies in focus, representing a maximum of 25 percent of yearly revenue.

2.5. The expectations of markets

The whole nature of markets can be described with a few divergent theories which in turn can strongly affect the event study results. Neoclassical economical interpretation is not just a theory, but a metatheory that sets implicit conditions and perceptions on

which economic theories are built. It has three fundamental assumptions according to Weinstraub (2007):

1) People have rational preferences among outcomes
2) Individuals maximize utility and firms maximize profits
3) People act independently on the basis of full and relevant information

If neoclassical principles are reflected to receiving order contracts, it means that signing every contract is made rationally with reasoned profit maximization in mind. Declining from projects without rational reason does not fit the neoclassical view. Irrational reasons in neoclassical interpretation could be for example favoring pet projects of a decision maker or choosing a particular project over others because of other personal preferences. If we assume that investors interpret world through neoclassical assumptions, investors would not weigh any implicit information about the contract but they would believe that every contract has a positive influence to company profits and therefore stock price. Neoclassical interpretation simplifies the actions of companies to be always profitable, which is a very strong assumption.

Differing from the neoclassical view is the rational expectations approach to economics which was coined by Muth (1961). The rational expectations theory assumes that each individual investor has his/her own rational expectations about stock prices and even if the individual estimate contains errors, large amount of individual investors makes the expectation correct on average, in other words no systematical error arises. This approach can be seen parallel with the strong form of efficient market hypothesis: the market prices stocks always correctly, but in this case not because all information is public, but because average of expectations implicitly includes all information, even the unpublished part of it.

The literature review of efficient market hypothesis showed that strong form of efficient markets doesn't apply in real markets. Same conclusion can therefore be done for full application of rational expectations approach. But if the approach is applied in a smaller scale than whole markets, it might change the outcomes of event study radically. The event study of order contracts is fundamentally based on the unexpected deviation from forecasted order backlog, so if we assume that order backlog forecast is based on the rational expected approach and therefore absolutely correct, anything unexpected is not possible and event study produces no abnormal returns because no deviation occurs when new information about contracts is released to markets.

Third fundamental approach that can be reflected to shareholder reaction of company events is the myopic approach. Kurz (cited in Samuel 2000) defines myopic decision making as an activity that ignores decision substitution possibilities arising from long-term business environment changes whereas nonmyopic decision making considers possibilities through the entire relevant time period. Therefore in myopic decision

making near-term goals are emphasized at the expense of long-term goals. Shareholder myopia is usually referred in articles when the reaction to long-term investments is being researched. If shareholders are myopic, they emphasize immediate effects of a company action instead of seeing the full long-term effect. This has been claimed to cause negative stock reactions to decisions that have positive overall net present value or that are otherwise measurably profitable. For example in a paper by Humphery-Jenner (2010) stock reactions to IT-related mergers and acquisitions were negative although the acquisitions were improving operations on average. Same kind of results were achieved in a study, where capital expenditure projects were categorized into immediate cash generating projects, non-immediate cash generating projects and joint venture related projects: although non-immediate cash-generating expenditures were not penalized with negative stock reaction as in Humphery-Jenner's (2010) research, they didn't cause any positive reaction either (Burton et al. 1999). The result can be explained with shareholder myopia or with the rational expectations theory.

Reflecting shareholder myopia on the subject of this thesis is not very essential. The projects related to received order contracts can last for months or even years, but from the shareholder point of view they are easily seen as immediate cash generators and most certainly not long-term expenditures. Negative effect of shareholder myopia is therefore far-fetched, but myopia could affect the stock reaction the other way around. If myopic approach is applied to interpretation of order contract stock reactions, it could mean that shareholders are not able to see implicit value of special contracts such as conquering new markets, signing the first commercial contract of new technology or getting a contract that implies for further contracts.

2.6. Summarizing the financial reaction to awarded order contracts

The theoretical background presented in chapters 2.3, 2.4 and 2.5 is summarized in Figure 1 to represent the whole pattern of explaining theories and factors affecting the outcome of this study. It starts the logical path from the notion of stock price and ends in the stock price reaction to order contracts.

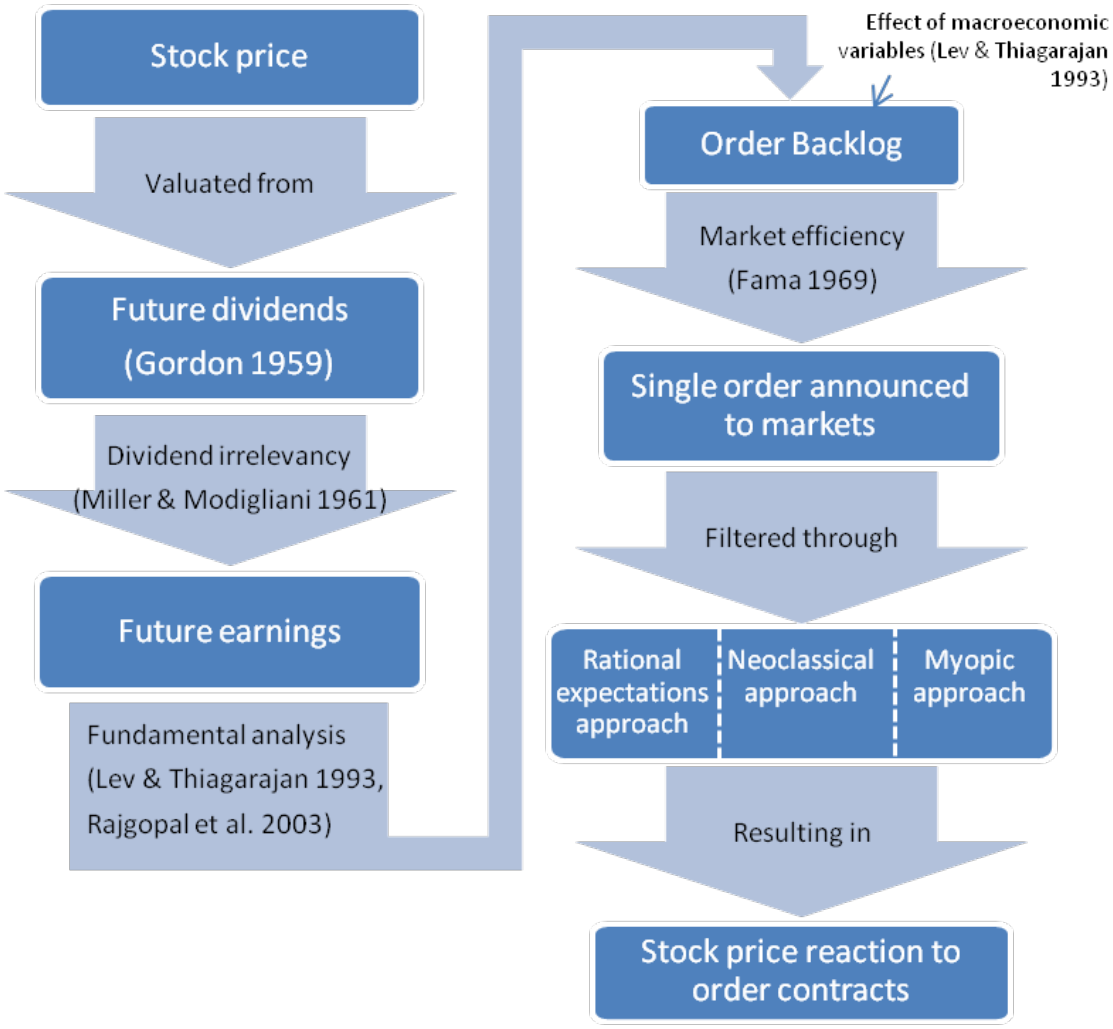

Figure 1. *The outline of theory rationalizing financial reaction to awarded order contracts*

The other stock valuation principles introduced in chapter 2.3 (APT and CAPM), which are based on arbitrage free markets, are omitted from the figure but it is still important to bear in mind that those approaches are valid at the same time. Essentially, under the market-based valuation principles the above process is implicitly done to every company and the market-based valuation is then applied to find the right balance of reaction between the companies. This approach will be used later in discussing the notion of "normal" returns of a company. In Figure 1, the market efficiency link between order backlog and single order depicts semi-strong form of market efficiency where stock price includes all past information and it reacts instantly to new information but it doesn't reflect insider information. Thus, in this case stock price includes past values of order backlog and forecasts of order backlog and it reacts to significant changes to the backlog but it doesn't include insider information about future contracts. Another noteworthy detail about the figure is the filtration of stock price reaction through three economic approaches. Even though the three approaches are parallel, they are not exclusive, so a part of order contracts could fall under the rational expectations approach producing no results, another part of order contracts could be interpreted

neoclassically with straightforward economic result and shareholder reaction while all the contracts could include long-term benefits or disadvantages not taken into account because of shareholder myopia.

2.7. Main hypotheses

The outlining of a theory that explains the cross-sectional variation in abnormal returns is listed as a sub-objective of step 9 in the event study process proposed by McWilliams and Siegel (1997), but to keep the theoretical background as whole the cross-sectional variation and the hypotheses linked to it are presented in this chapter. The results of the second step, outline of the general theory, are also included in the hypotheses formulation. McWilliams and Siegel (1997) emphasize that if a researcher has outlined cross-sectional variation in the theory, the predictions should be tested with regression. Another type of more detailed analysis is to divide the initial sample into subsamples with some common characteristic.

Firstly, the result of this research may be that no statistically significant abnormal returns linked to announcements of received order contracts occurs. There are many reasons for that, including: 1) rational expectations of the markets and the company actions, thus single contracts are continuously calculated to stock price 2) leakage of information prior to event window, thus not being able to capture the abnormal returns with the time periods used and 3) abnormal returns occur but they are too small to be captured with the method. Based on these arguments, a null hypothesis is formed:

> ***Null hypothesis****: There is no stock market reaction to announcements of received company order contracts.*

The null hypothesis is important for the testability of other hypotheses. All the hypotheses are tested against null hypothesis with statistical methods to show the power of the results for rejecting the null hypothesis. If the evidence against null hypothesis is not strong enough, the null hypothesis is failed to reject. Null hypothesis cannot be proven, so if the null hypothesis is failed to reject, it doesn't necessarily mean that there is no stock market reaction to announcements of awarded order contracts. Instead, it shows that the reaction is not found with this particular research design.

The main hypothesis for this study is the opposite of null hypothesis. The theory outlining the main hypothesis is summarized in chapter 2.6.

> ***Hypothesis 1****: Investors positively react to the announcements of order contracts.*

Hypothesis 1 seeks to answer the second research objective: "Define the general stock market reaction to announced order contracts". A direction of the effect is added based on theory review. McWilliams and Siegel (1997) stress the importance of predicting the

direction of the stock price effect a priori and gives examples of weakly explained abnormal returns in some studies. These studies have presented the direction of the effect ambiguously, such as stating "we believed that such reactions will generally be negative, but they could be positive or neutral" (Worrell et al. 1991, p.638). Leaving the theory open in the building phase can easily lead to unexplained abnormal returns as the results are presented.

Four additional hypotheses are seeking for achieving research objectives 2a and 2b. Hypothesis 2 compares the average abnormal returns of the two case companies. The basis for the direction of the economic effect of hypothesis 2 derives from the theory summarization (Figure 1). If we assume that the economic approach of the investors is the same in both companies, dividend irrelevancy applies and the average size of received orders is controlled, there are two systematical factors that are left to make a difference different stock price reaction between the companies: the portion of order value contributing to company earnings and the market efficiency level, or, in other words the newness of information to the market. The company-level relation of order size and earnings contribution can be derived from the net income percentage. A higher (lower) net income level means that a larger (smaller) amount of order value goes to the shareholders resulting in higher (lower) stock price effect. The other factor, leakage of information, is hard to control, and it can be very significant factor compared to effect calculated by net income, thus possibly explaining results that could diverge from the results predicted by the net income percentage. Theoretically, the value of the capital transferred to shareholders per contract announcement can be calculated by multiplying the order contract value by net income percentage. For example, with a net income level of 10 percent, a 100 million euro contract would result in 10 million euro capital transfer to shareholders. In like manner, if the order-specific value is changed to average order contract value and average net income level, the average capital transfer per contract of a certain time period is possible to calculate.

> ***Hypothesis 2****: Stock price reaction to announced order contract is stronger (weaker) in a company with a higher (lower) net income percentage.*

In hypothesis 2 the value of order contracts is controlled, but if the value of order contract is changed into independent variable, the correlation of abnormal return and order contract value is possible to examine. A more (less) valuable contract is expected to result in a greater (smaller) stock price effect, because the amount of capital transferred to shareholders is larger (smaller), formulating third hypothesis. The same proportion of contract value is expected to be transferred to shareholders not depending on the size of the contract, so the correlation is anticipated to be linear.

> ***Hypothesis 3****: The positive abnormal return reaction is correlated with the value of the order contract.*

Previous hypotheses concern the general or company-level stock price reactions. To deepen the analysis further, the effect of internal differences in companies is hypothesized. Comparison of sales and earnings of internal business areas can reveal different EBIT (earnings before interest and taxes) percentages between business areas. Again, higher (lower) EBIT predicts higher (lower) stock price effect. An example to describe the logic: business area A with 10 percent EBIT and business area B with 20 percent EBIT both sign a contract of the same value. Theoretically, investors should appreciate the contract of business area B twice as much as business area A, because the amount of capital transferred to shareholders is two times as large. Compared to second hypothesis, where euro denominated values can be estimated, the absolute values cannot be compared in this case, because after EBIT there are financial items, such as corporate tax, that are deducted from the capital that eventually is transferred to shareholders. However, the comparison of absolute values is not essential when examining internal differences of companies.

> ***Hypothesis 4****: The stock price reaction is affected by the operating margin of the business area to which the received contract belongs.*

The last hypothesis tests the investors' ability to incorporate macroeconomic variables into their reaction of order contracts. Lev & Thiagarajan (1993) found the inflation level to be a fundamental factor that affects how order backlogs are valued in company stock prices. The fifth hypothesis goes a step further, predicting that besides size of order backlog, the effect of inflation to single order valuation is found.

> ***Hypothesis 5***: *The stock price reaction includes the effect of current inflation: during times of high inflation the order contracts are not valued as much as during low inflation.*

These five hypotheses are tested against null hypothesis to reach the second research objective and its subobjectives. In the hypothesis formation the pitfalls drafted by McWilliams and Siegel (1997) are noted by building the foundations of hypothesis solidly to the theory.

3. METHODOLOGICAL VARIATION OF EVENT STUDIES

Building a theoretically solid base to justify the general financial reaction and the content of hypotheses is an integral part of well-founded event study research, but equally important is to select the methodological details of event study to achieve a valid and reliable study. Going back to the event study implementation procedure suggested by McWilliams and Siegel (1997), the research design details are covered in steps 3 to 9. These steps are described in the article briefly, so in this chapter the significance of each step and methodological options for the different parts is discussed.

3.1. Selecting sample companies and events

The sample companies and their events construct the data set of an event study and thus form the empirical base for the whole study. Naturally, the selection of sample is a crucial part which defines many other aspects of the study. Some important details to consider when choosing the sample are sample size, sample representativeness and sample accuracy. Sample size is probably the most discussed aspect in event study literature. Brown and Warner (1985) note that small sample sizes, meaning less than 50 companies, cause inaccuracy to statistical significance analysis, because stock returns of a single company are not normally distributed but show some skewness and kurtosis. To control the non-normality McWilliams and Siegel (1997) suggest additional significance analysis methods, if sample size is less than 30 companies. However, it should be noted that small sample size itself does not skew the actual abnormal return results but only the stated significance levels. Another advantage of large sample size is the increased power of detecting abnormal returns. MacKinlay (1997) presents tabulated and graphed information of the sample size related to the power of rejecting null hypothesis, and it is a good reference to the initial stages of sample planning.

Sample representativeness means the extent of how the sample represents the group of which it claims to represent. Not many event studies discuss the representativeness of their sample, and the descriptions vary a lot. Becker and Olson (1986, p.430) state their sample of employee strikes in U.S. to be "generally representative of U.S. manufacturing" without further explanation. Lee (1997) compares the collected sample to another sample of the same subject and comes to a conclusion that representativeness of Japanese corporate layoffs between 1990 and 1994 is achieved. Chaney et al. (1991) takes the analysis a bit further by acknowledging that their product announcement sample collected from Wall Street Journal is not representative of all new products, but

it is rather a sample of "significant" products filtered through Wall Street Journal reporting bias. Indeed, the source of sample events can bring a strong bias and it is always wise to discuss about sample representativeness, if the data is not collected from a primary source.

Sample accuracy is not an established notion in event study theory, but in here it means at least two things: the certainty of the moment when a sample event occurred and the trading frequency of a sample security. For a large multinational corporation with a lot of analyst coverage the issue of accuracy is probably not a problem, because the events are covered in business media quickly. Still, a mistake in the choice of source medium can bring inaccuracy to the identification of correct event day or time, for example if a magazine is not published on a certain weekday, the reporting of events occurring on those days can lag. The trading frequency of a security brings inaccuracy to the results if trading is sparse compared to the resolution of examination. Conducting event studies on a small stock exchange with thinly traded stocks is under analysis by Bartholdy et al. (2007) and the conclusions show that event studies are possible with thinly traded stocks, but they need some special methodological solutions to be performed validly. The main points of the results state that minimum of 25 events is necessary to achieve significant results, thinly traded stocks need trade to trade return adjustments, detecting abnormal performance of less than 1 percent is generally not expected, and nonparametric significance tests perform better than parametric tests.

When the sample is built, it is practical to summarize characteristics of the sample, such as market capitalization, industry representation and distribution of the events through time (MacKinlay 1997). The internal dynamics of the sample and any potential biases are useful to note. One pitfall of the sample dynamics can be ignoring the effect of overlapping events across the sample. A good example of overlapping is a study of automobile recalls (Jarrell & Peltzman 1985). A reexamination of the research by Hoffer et al. (1988) revealed that a recall by one manufacturer affected the stock price of another manufacturer. Thus, the sample events of one company were contaminating the data of other company. Forgetting this kind of dynamism in the sample could lead to serious distortion in the results.

3.2. Length of the event window

The fourth step in the event study procedure is defining the length of event window. Besides the actual event window there are some established notions of different time frames surrounding events in event studies. These time frames include estimation window, pre-event window, event window and post-event window (for example Henderson 1990; MacKinlay 1997). Figure 2 shows the positioning of typical time windows in relation to each other.

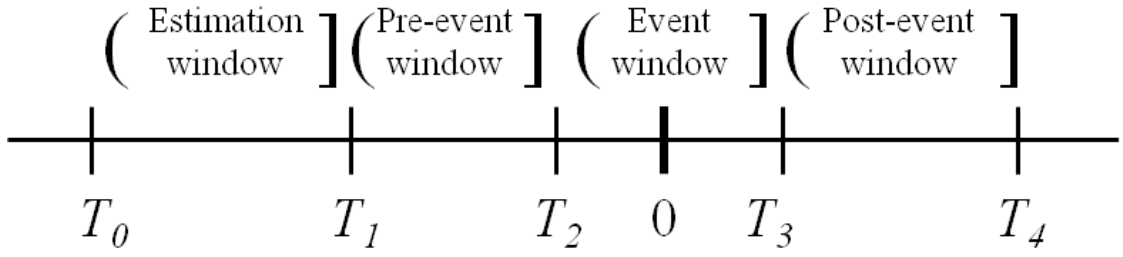

Figure 2. *Time line for an event study (MacKinlay 1997)*

In event studies time is usually kept relative to the moment of the event, marked with t=0. Event window usually includes at least t=0, and it is surrounding t=0 symmetrically or asymmetrically. Furthest in the past is the estimation window. It is used to estimate the parameters that are included in calculation of "the normal performance" of a stock. Between estimation window and event window is pre-event window. It is used to separate the possible information leakage that could contaminate the estimation window (see for example Klassen & McLaughlin 1996). Stock prices from the pre-event window are therefore omitted from the estimation window and also from the event window. Stock returns of the post-event window are sometimes included in the estimation window. (MacKinlay 1997) This is especially useful if the event window is long and the fundamentals of the company or the industry and consequently the estimation parameters might have changed during the event window.

Selecting the proper length of the event window is a two-sided question. McWilliams and Siegel (1997) advice to justify the length of the event window if it exceeds two days. The positioning of event window depends on the level of unexpectedness of the selected event. A good example of unanticipated event is a sudden natural catastrophe such as earthquake. No one could have had the information content of the event before the earthquake, so the event window is in that case justified to begin from the moment when the earthquake occurred. In contrast, an event can be considered somewhat anticipated if it is insider information that could leak outside before the actual announcement is given to markets. Other source for anticipation could be an event that "is just bound to happen", for example firing a CEO that has done something controversial and is not able to defend his position. Each event study has to be analyzed for the possibility of event expectedness and adjust the event window considering the leakage or expectedness of information. This can mean setting the event window to start as early as months before t=0 (eg. Lubatkin 1987; Worrell et al. 1991). Besides unintentional information leakage, identifying the exact event time can be a problem. The issue is very clear if the information source of events is a daily newspaper. When an announcement is released to markets, it is usually in the newspapers one day after the announcement, but in special cases it could last two days or more. Anyhow, newspaper as the source for event timing is not very contemporary method thus is should not generally be used if better sources are available because of the timing problem.

Nowadays good sources for company events are for example the press release archives of stock exchanges or electronic business newswire services. As listed companies in most countries are obligated by the law to notice stock exchanges of their major news in timely fashion, the time stamps in stock exchange releases are the primary sources of announcements and the exact time of announcement can be tracked to the second when announcement was made. Business newswire services are another source for accurately time stamped events as they work often as mediators between a company and stock exchange (for example Business Wire 2011). Carefulness must be observed if using newswires as a source, though, as newswires can also gather news from other sources with a lag of several hours to days. Generally speaking, the more ambiguity in identifying the actual event time, the wider the event window has to be to certainly capture the actual event.

The reason why McWilliams and Siegel (1997) suggests avoiding longer event windows (if they are not necessary) is because longer event windows create at least two methodological problems. The statistical power of the event study technique weakens with longer event windows. Brown and Warner (1985) noticed significant change in rejection percentage of null hypothesis between the event window lengths of one day and eleven days. Another issue about longer event windows is controlling the confounding events. Confounding events are other economically significant events that are happening to the company during event window (McWilliams & Siegel 1997). Obviously, longer event windows have a higher possibility of containing confounding events thus requiring additional methods to control the effect of those events. The methods for that purpose are discussed more in next chapter.

To give a general idea of what kind of event windows are use in past researches of various event types, the following list of past event study researches is gathered from renowned business and financing related journals published between 1976 and 2008. It is not supposed to be a complete list of past important event studies, but rather a glimpse to what kind of events have already been studied with what research design parameters. The publishing years and subjects are selected to cover a wide range of event studies.

Table 1. *Past event studies*

Authors	**Type of events**	**Sample size (N = Overall, n_0 = Smallest subsample)**	**Length(s) of event window(s)**
Abowd et al. (1990)	HR decisions, general, compensation, staffing etc.	N=452 n_0=2	-10 to -3 days -2 to +2 days
Adams et al. (1999)	Winning a quality award	N=48 n_0=7	1 day
Becker (1987)	Concessionary settlements	N=166	90 to +90 days
Bradley (1980)	Mergers by interfirm tender offers	N=258 n_0=33	-60 to +60 days
Busse & Green (2002)	Appearance in CNBC analyst call	N=322 n_0=42	Multiple from -15 minutes to +20 days
Chaney et al. (1991)	Introduction of new products	N=1101 n_0=3	-5 to +5 days -1 to +1 days -3 to +3 days -5 to +1 days
Chatterjee et al. (1992)	Mergers in relation to cultural differences of companies	N=30	-10 to +5 days
Chauvin & Guthrie (1994)	Listed as a "best company for working mother"	N=183 n_0=20	-2 to +2 days
Chen et al. (2001)	Layoff announcements	N=349	Multiple from -750 to + 750 days

Table 2. *Past event studies (continued)*

Authors	**Type of events**	**Sample size (N = Overall, n_0 = Smallest subsample)**	**Length(s) of event window(s)**
Clinebell & Clinebell (1994)	Advance notice of plant closure	N=98 n_0=34	-5 to +5 days
Davidson III & Worrell (1988)	Corporate illegalities	N=131	Multiple from -90 to +90 days
Davidson III et al. (2002)	CEO succession in relation to industrial origin	N=55 n_0=12	-10 to +10 days -5 to -2 days -1 to 0 days
Firth (1976)	Earnings announcements	N=87 n_0=12	-10 to +9 days
Greer et al. (1980)	Employee strikes	N=91 n_0=27	-30 to +30 months
Hall & Rieck (1998)	Voluntary positive corporate social actions	N=99 n_0=16	Multiple, from -5 to +5
Hillier et al. (2007)	Layoff announcements in UK	N=322 n_0=42	Multiple from -750 to +750 days
Kelm et al. (1995)	R&D announcements	N=501 n_0=197	-1 to 0 days
Klassen & McLaughlin (1996)	Environmental awards and crises	N=140 n_0=18	-1 to +1 days
Koh & Venkatraman (1991)	Formation of joint vetures	N=239 n_0=50	-1 to 0 day

Table 2. *Past event studies (continued)*

Authors	**Type of events**	**Sample size (N = Overall, n_0 = Smallest subsample)**	**Length(s) of event window(s)**
Lee (2001)	Name change to .com	N=59 n_0=27	-1 to +1 days
McGuire & Dilts (2008)	ISO 9000 certification announcement	N=204 n_0=22	-1 to 0 days 0 to +1 days
Meznar et al. (1994)	Withdrawal from South Africa during apartheid	N=39 n_0=19	Multiple, from -30 days to +10 days
Nayyar (1995)	Customer service changes	N=324 n_0=2	-1 to +1 days
Pilotte (1992)	Announcing new financing solutions	N=379 n_0=19	0 to +1 days
Poon et al. (2001)	Corporate restructurings	N=1053 n_0=93	-1 to +1 days
Reuer (2001)	Joint venture partner buyouts	N=139 n_0=50	Multiple from -5 to +5 days
Seth (1990)	Mergers by interfirm tender offers	N=104 n_0=27	-40 to +5 days
Singh & Montgomery (1987)	Corporate acquisitions	N=77 n_0=37	-5 to +100 days
Tsetsekos & Gombola (1992)	Foreign and domestic plant closures	N=282 n_0=5	Multiple, from -60 to +60 days

Table 2. *Past event studies (continued)*

Authors	**Type of events**	**Sample size (N = Overall, n_0 = Smallest subsample)**	**Length(s) of event window(s)**
Warner et al. (1988)	Top management changes	N=247 n_0=42	Multiple, from -36 to +12 months
Woolridge & Snow (1990)	Strategic investments	N=767 n_0=23	Multiple, from -1 to +10 days
Worrell et al. (1991)	Layoff announcements	N=194 n_0=30	Multiple from -90 to +90 days
Worrell et al. (1997)	CEO given a "new hat"	N=522 n_0=59	-60 to +60 days -5 to +5 days

As Table 1 shows, event windows range from minutes to years so everything in between is possible. More important is that the other details of event study research design must be fitted to match the requirements of event window length. For example in the research by Busse And Green (2002), where event analysis timeframe resolution is as small as 0,25 minutes, the statistical significance has to be determined with a nonparametric bootstrap algorithm because intraday returns are not normally distributed, which is the requirement for parametric significance tests. Bootstrap algorithms are elaborated later in chapter 3.5. In the other end, long-range event studies (event window more than 12 months) are sensitive to different aspects of event study. In contrast to short-range event studies, adjustment of risk level is critical in calculation of abnormal returns in long-range event studies. Even 50 percent misestimation of beta risk level is not very significant in short-range studies as average daily expected returns of stocks are only about 0,05 percent. Conversely, when event window is lengthened to months, the 50 percent misestimation is a significant error source. (Kothari & Warner 2007) In short event windows the risk level can also be expected to be constant during the event window, but in long event windows it is reasonable to calculate the sliding average of risk during the event period.

Among the studies listed above there are many studies that include multiple event windows. In many cases the multiple event windows serve different purpose. For example in the research by Abowd et al. (1990) the event window from -10 to -3 days examines the possible leakage of information but the main focus is in the event window from -2 to +2 days. Same approach is used by Davidson and Wallace (1988) where one event window is -5 to -2 days but the main results are derived from event windows of -10 to +10 days and -1 to +1 day. Table 1 also shows how the day after t=0 is usually included in the event window because the timing of announcements is hard to specify and control. Especially today's international business environment can cause difficulties in identifying t=0: let's say a notable announcement of a multinational company's Asian operations is given during active stock trading hours in Asia, but the announcement concerns a stock which is listed in a European stock exchange where trading hours have already ended at the time of the announcement. In that case the actual stock price effect would realize at the time when the stock exchange is reopened on the next day in Europe, assuming there is no prior information leakage. Therefore it can be risky to exclude day t+1 from the event window.

Studies that have chosen event windows of several months in length have some common characteristics. The covered events are often a culmination point of a long-lasting negative or positive progression. Good examples are the corporate layoff studies by Chen et al. (2001), Worrell et al. (1991) and Hillier et al. (2007) or employee strike study by Greer et al. (1980). The long event windows are relevant in those studies to examine how investors perceive the atmosphere of a company before the announcement

of a significant event, which makes the progression explicit. Longer event windows would be irrelevant for events such as sudden death in top management or natural catastrophe, where there are no signs of upcoming event beforehand. Nonetheless, these studies usually include also a shorter event window to compare the magnitude of long-term reaction and announcement reaction.

Besides setting the proper length of the actual event window, the length of estimation window must be set too. The function of estimation window is to estimate parameters of the model which is used to calculate normal returns of the stock and it does not include the actual event time. Some return models, such as market-adjusted model, do not use any estimation window. The justification for estimation window length is rarely discussed in researches, but the established average length is around 100 to 180 days (for example Kelm et al. 1995; Nayyar 1995; McGuire & Dilts 2008). A short estimation window can cause misestimation to the parameters, because single events during the estimation window influence the parameters too much. (Abowd et al. 1990; MacKinlay 1997) In the other end, too long estimation windows do not capture the fluctuation of normal return model parameters over time. The fundamentals of a stock or a whole market can change thus making a one-year-average of parameters less accurate than six-month-average. Another point against long estimation window is the effect of overlapping. If the analyzed events are close to each other, the event estimation windows are probably overlapping other events, causing possible estimation errors. Poon et al. (2001) took overlapping estimation windows into account by using only 50-day estimation window but 100-day and 250-day estimation windows were also tested to verify the robustness of results despite the estimation window length. All in all, the chosen estimation window length must be a compromise between the disadvantages and benefits of long and short estimation windows.

Summarizing the meaning of different time frames around an event in event studies, the proper length of the event window can be anything between years and minutes, but the most essential matter is to justify the usage of selected event window. A good question to pose yourself is "How long before or after t=0 the information content of the event could influence the stock price?" The research objective also influences the appropriate event window length: is the research seeking for long-term awareness of investors about a subject or only the instant effect of an event. The downsides of especially short or long event windows should be compensated with other research design details for example seeking higher statistical significance for longer event windows by choosing the correct sample quantity and quality.

3.3. Confounding events

The event study procedure continues from setting the event window to the control of confounding events. In the search for abnormal returns of an event it is assumed that the effect of the event has been isolated from the effects of other events. These other events

are called confounding or contaminating events. McWilliams and Siegel (1997) point out how researchers do not seem to be very perceptive of the issue about confounding events. One reason for that could be the ambiguity of confounding events, in particular what events should be considered confounding and what should not. Other reason is the impact to sample size when rejecting events with confounding events. This reason is highlighted in a research by Meznar et al. (1994, p.1639): "Although we would have preferred a larger protection window around our events, such an increase would have eliminated so many events from the pool that the generalizability of the study would have been seriously impaired."

The following examples of controlling confounding events are gathered from the articles presented in Table 1. Many of the articles do not mention anything about confounding or contaminating events. This is especially alarming in studies with short event windows and small sample sizes as even one confounding event could influence the results significantly. For instance a study by Singh and Montgomery (1987) has an overall sample size of 77 events with smallest subsample being 37 events, but no identification of confounding events is done. McWilliams and Siegel (1997) replicated two CSR related researches made in 1994 and 1995 searching for confounding events that were ignored in the original researches and found out that the original sample of 106 events contained 367 confounding events during the longest event windows used in the researches. After filtering events that had confounding events and rerunning the abnormal return calculations, the results were no longer significant, giving a strong statement for better control of confounding events. Another cautionary example of carelessly controlled confounding events is a research by Adams et al. (1999) which has a sample size of 48 events with smallest subsample being 7 events. The main results are presented without clearing confounding events; although in the sensitivity analysis confounding events are noted, but for some unexplained reason only negative confounding events are excluded. The result of this sensitivity analysis is quite obvious: after dropping out events that included negative confounding events the analysis yielded "slightly more significant evidence of a stock price increase on the announcement day." (Adams et al. 1999, p.600)

When the controlling of confounding events is performed, the first step is to use a broad news source to identify any company-specific, possibly contaminating events during event windows. In practice it is a search through local business newspapers (in US, for example Wall Street Journal, New York Times and Business Week (McWilliams & Siegel 1997; Davidson III et al. 2002)) or lately the usage of aggregated news service such as Nexis (used by Nayyar 1995). The next step is to define which of the events that are found have the contaminating effect and which are insignificant to stock prices. The practice for classifying confounding events has changed dramatically over time. Specifically in older studies the control for confounding events is not done at all or it is limited to a few types of events, for instance interim reports (Firth 1976). Greer (1980) examines the effect of strikes and controls only other strikes that occur during the event

window, similarly to a R&D related study of Kelm et al. (1995) where only other R&D events are regarded confounding. Many authors do not present the full list of confounding events checked in study, but only give some examples. These lists generally include events such as earnings announcements, dividend announcements, layoff announcements, mergers, secondary offerings and personnel changes (Woolridge & Snow 1990; Pilotte 1992; Tsetsekos & Gombola 1992; Clinebell & Clinebell 1994). One study refers only to "major events" (Hall & Rieck 1998) and one study lists other specific elimination criterion such as the terrorist attack on 11th September 2001 (McGuire & Dilts 2008). McWilliams and Siegel (1997) list thirteen event types that they assume to be confounding based on earlier event studies:

1) Restructuring / Divestiture
2) Price changes
3) New products
4) Dividend / Earnings announcement
5) Joint venture formation
6) Acquisition activity
7) Litigation / Labor unrest
8) Major executive changes
9) Major initiatives by rivals
10) Forecasted changes in earnings or sales
11) Layoffs
12) Debt or equity related event
13) Contract awards

The list is extensive but it could still be expanded with many of the event types included in Table 1. In essence if it is not certain that an event is insignificant, the safer bet is to assume that it is confounding. Studies by Worrell et al. (1997) and Nayaar (1995) have taken a strict policy with confounding events, disqualifying events from the sample in case of any other events. For the purpose of credibility and replicability of a study, the full listing of confounding event types acknowledged in the particular study is useful.

Another issue is setting the time frame in which confounding events are controlled. A natural choice would be the length of the event window, but different approaches are also found. Probably trying to avoid too small sample size Tsetsekos & Gombola (1992) only disqualify events that have confounding events between -5 to +5 days despite the detail that their longest event window is from -60 to +60 days. Likewise, Worrell et al. (1991) control only the actual event day in spite of the longest event window being -90 to +90 days and Woolridge & Snow (1990) check the confounding events from -1 to +1 days against the longest event window of -10 to +1 days. To avoid confusion it is therefore essential to precisely mention if the confounding events are not controlled for the whole event window.

The usual handling of events with confounding events is to fully ignore them from the event study sample. If there is ambiguity in the contaminating effect of certain event types, other option would be to do a sensitivity analysis by treating the sample with confounding events and without confounding events separately. Klassen and McLaughlin (1996) use this kind of approach, presenting statistics and results of full sample and cleaned sample in parallel throughout the event study.

Based on the findings from past literature the key points of controlling confounding events are:

1) Using a broad news source to find company-specific events that occur during the examined time period
2) Identifying events that are confounding in the particular study and listing the types of confounding events
3) Setting the time frame where confounding events are controlled, preferably same as event window
4) Either fully removing events with confounding events from the sample or treating full sample and cleaned sample separately
5) Reporting the procedure with confounding events in a research properly

3.4. Calculating abnormal returns

The importance of the sixth step in the event study procedure cannot be underlined too much because the calculation of abnormal returns is included in the basic definition of event studies. The proceeding steps have essentially been selecting and preparing the sample for calculation of abnormal returns and the following steps are detailed analysis of calculated abnormal returns, so the whole procedure can be seen to converge in this step. The calculation of abnormal returns begins by defining how to calculate returns in general. As Henderson (1990) mentions, most event studies do not mention how the calculation of returns is done, although it also seems not to make considerable difference. There are two main methods of calculating a return for single period: *arithmetic return* and *continuously compounded (or logarithmic) return*. Arithmetic return is simply the percentage of change between the initial value of an investment (V_i) and the final value of an investment (V_f):

$$r_{arith} = \frac{V_f - V_i}{V_i} \tag{5}$$

Continuously compounded return is the logarithmic value of the ratio between V_f and V_i:

$$r_{log} = \ln\left(\frac{V_f}{V_i}\right) \tag{6}$$

Continuously compounded return calculation is used in the most part of event studies as it has a few advantages over arithmetic returns. The return distribution normality is improved when using logarithmic returns and negative values are transformed to positive. Converting daily values to longer time periods is also easier with logarithmic return calculation. (Henderson 1990)

The abnormal return measures the stock market's reaction to new information, so to calculate the abnormal returns of a stock, we need to determine normal returns i.e. what would the stock returns have been without the release of new information. So, for company i and event period τ the abnormal return $AR_{i\tau}$ is

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau}|X_\tau) \quad (7)$$

where $R_{i\tau}$ is the actual perceived return and $E(R_{i\tau}|X_\tau)$ is the expected normal return for the same period with conditioning information X_τ for the normal return model. (MacKinlay 1997) The actual returns are unambiguously retrieved from stock price information source thus the only choice left to researcher that is affecting the abnormal returns is the choice of normal return model. The various normal return models can be classified into three types: *mean-adjusted return models*, *market-adjusted return models* and *conditional (or risk-adjusted) return models* (Henderson 1990). If minor details between all return models are regarded, the total number of different models is much higher than three but this grouping combines the basic approaches into three types. Thus, each return model type can include many variations of the model that are close to each other.

Mean-adjusted return model is one of the simplest return models used in event studies and it has no common variations. In mean-adjusted return model a constant is subtracted from the event period returns. The constant is the average return of the company during the estimation period. The expected normal return $R_{i\tau}$ for asset i in period τ is

$$R_{i\tau} = \mu_i + \zeta_{i\tau} \quad (8)$$

where μ_i is the mean return during the estimation period and $\zeta_{i\tau}$ is the disturbance term with an expected value of zero. (MacKinlay 1997) Combined with the abnormal return formula (7) the mean-adjusted abnormal return for asset i in period τ is

$$AR_{i\tau} = R_{i\tau} - \mu_i + \zeta_{i\tau} \quad (9)$$

Although this model is very straightforward, it generates very similar returns compared to more advanced return models. Brown and Warner (1985) compare the abnormal detection performance of mean adjusted returns, market adjusted returns and market model returns and find out that the difference in detecting abnormal performance is only 2-5 percentage points. On the contrary, in the simulation of abnormal return detection by Dyckman et al. (1984) mean-adjusted returns did not perform as well as market

model. Another possible error source for mean-adjusted return model is the general trend of market. Klein and Rosenfeld (1987) examined return residuals during downward and upward trends of market and found out significantly biased residuals. The problem gets worse if a change in market trend occurs just between the estimation period and the event period or if the stock has undergone a runup during the estimation period. For these reasons the usage of mean-adjusted returns must be supplied with a careful control of the abovementioned factors impacting the results.

Market-adjusted return model is as straightforward as mean-adjusted return model. Because it has no estimation period, it can be used in situations where past stock data is unavailable, for instance in an initial public offering (Ritter 1991). Market-adjusted abnormal returns are calculated by subtracting the return of the market for the event period from the return of the stock for the same period. (Henderson 1990) In other words, the expected normal return $R_{i\tau}$ for asset i in period τ is the same as return of the market $R_{m\tau}$:

$$R_{i\tau} = R_{m\tau} \tag{10}$$

Combined with the basic abnormal return formula (7) the abnormal return for asset i in period τ according to market-adjusted return model is

$$AR_{i\tau} = R_{i\tau} - R_{m\tau} \tag{11}$$

The abnormal return detection performance and bias of residuals of market-adjusted return model has been examined in a couple of studies with mixed results (Brown & Warner 1980; Dyckman et al. 1984; Klein & Rosenfeld 1987). Brown and Warner (1980) implied that the power of the model is equivalent to sophisticated market models, but Dyckman et al. (1984) found market-adjusted model to be weaker than other market models. Klein and Rosenfeld (1987) noticed the same weaknesses for market-adjusted return model than mean-adjusted return model: the upward and downward trends or stock run-ups create significant residuals biasing the results. Using market-adjusted returns is thus not encouraged except in the cases where estimation process is not possible.

Conditional or risk-adjusted return models are a large collection of return models in which the risk level of stock is taken into account in return calculations. One of the earliest risk-adjustment methods is *control portfolio risk-adjustment*. In this method a portfolio of sample stocks is assembled with the condition that it has the same estimated risk level (or beta) than market portfolio. Then the return of the constructed portfolio is calculated. The abnormal returns are estimated by subtracting the market return from portfolio return. Brown and Warner (1980) examine the effectiveness of control portfolios and conclude that it is not as accurate as other methods. Henderson (1990) discusses wider usage of control portfolio adjustment method giving an example of industry portfolio that could serve as a control portfolio for an event company in the

same industry. In that case the excess return of an event would be the difference of returns between the event company and industry portfolio. Although the idea is logical, the control portfolio risk-adjustment has not gained much popularity, probably because many researchers were already strongly engaged in other methods (Henderson 1990) and because of the performance problems that portfolio weighing brings (Brown & Warner 1980).

Another subcategory of risk-adjusted return models is *regression models*. Generally, in regression models some factors are regressed from the data and those factors are applied to calculation of excess returns. The estimation window has a big role in these methods because it is used to calculate the factor. The simplest regression model is the *single-index market model.* It is sometimes referred simply as the *market model* (Chaney et al. 1991; Kelm et al. 1995) or *OLS market model* (Brown & Warner 1985), but to separate it from multiple index models it is clearer to refer to it as single-index market model or *SIMM*. According to SIMM the normal return of a company is expected to correlate with the market return which adjusted with the company-specific beta (or market sensitivity level). Thus, the expected normal return $R_{i\tau}$ for asset i in period τ is

$$R_{i\tau} = \alpha_i + \beta_i R_{m\tau} + \varepsilon_{i\tau} \tag{12}$$

where α_i is the intercept estimated from the regression of the estimation period, β_i is the market sensitivity level estimated from the regression of the estimation period, $R_{m\tau}$ is the market return for period τ and $\varepsilon_{i\tau}$ is the error term with an expected value of zero. (Henderson 1990; MacKinlay 1997) Combined with formula (7), SIMM abnormal returns are

$$AR_{i\tau} = R_{i\tau} - (\alpha_i + \beta_i R_{m\tau} + \varepsilon_{i\tau}) \tag{13}$$

and since the expected value of the error term $\varepsilon_{i\tau}$ is zero, all residuals of the subtraction is termed the abnormal return. Despite the relative simplicity of the single-index market model, it offers a significant improvement to mean-adjusted and market-adjusted return models (Brown & Warner 1985; MacKinlay 1997). In detail, market-adjusted return model can be seen as a restriction of SIMM with α_i set to zero and β_i set to one, but adding those factors to model cleans the portion of the stock return that comes from the variation of market return. This improves the detection ability of abnormal returns. (MacKinlay 1997)

A bit more complex regression model is the capital asset pricing model (CAPM) described already as a stock valuation principle in chapter 2.3. Based on CAPM, the expected normal return $R_{i\tau}$ for asset i in period τ is

$$R_{i\tau} = R_{f\tau}(1 - \beta_i) + \beta_i R_{m\tau} + \varepsilon_{i\tau} \tag{14}$$

where $R_{f\tau}$ is risk-free rate of return during period τ, β_i is the risk-level of the asset, $R_{m\tau}$ is the market return for period τ and $\varepsilon_{i\tau}$ is the error term with an expected value of zero. Beta-value is calculated by regressing $R_{i\tau}$ on $R_{m\tau}$ in similar fashion as in the SIMM, but with the difference of subtracting risk-free rate of return from $R_{i\tau}$ and $R_{m\tau}$ before the regression analysis. The above formula is essentially the same as CAPM stock valuation equation (4) but in this form it can be seen easier how CAPM is consistent with the SIMM if β_i and $R_{f\tau}$ are stable. MacKinlay (1997) discusses the usage of CAPM in event studies and notes that it was a common method during 1970s, but later the anomalies found by researchers, such as Fama and French (1996), have implied that results achieved with CAPM could be sensitive to the restrictions of the model. The performance difference in event studies between SIMM and CAPM, in favor of CAPM, compared to the sensitivity problem is very small, so the usage of CAPM has almost discontinued.

Adding more elements to the normal return calculations are the *multiple index models*. They are not a specific model, but a common name for regression models where more factors are added to improve the explaining power of normal return model. For instance industry factors are commonly used (for example Langetieg 1978; Sharpe 1970 and Sharpe et al. 1995 cited in MacKinlay 1997). Multiple index models are very analogous to arbitrage pricing theory, which is a stock price valuation method described earlier. A generic formula for multiple index model return calculation for asset i in period τ is

$$R_{i\tau} = \alpha_i + \beta_i R_{m\tau} + \beta_{xi} R_{x\tau} + \cdots + \varepsilon_{i\tau} \qquad (15)$$

where α_i, β_i, $R_{m\tau}$ and $\varepsilon_{i\tau}$ are as in the SIMM, and further sensitivities are added to the model with β_{xi} and $R_{x\tau}$ (Henderson 1990). The two additional factors described in three-factor CAPM (book-to-market ratio and market capitalization) are potential options for multiple index return models. The usage of multiple index models is a double-edged question. The gains of multiple index models are marginal compared to single index market model, because the market factor seems to explain most of the variation. The variance reduction is greatest in situations where the sample companies are alike or have common characteristics, so in those cases the usage of suitable additional sensitivity indices could be useful in relation to the resources that have to be put to building the index. Otherwise, the benefits of multiple index models are rather limited. (MacKinlay 1997)

One important element of calculating abnormal returns is the measurement of independent variables. In mean-adjusted return-model the only independent variable is the mean of returns, and the options of return calculations were already discussed. In other models the market return $R_{m\tau}$ is an independent variable which has different options for its calculation. Market returns are based on changes in market indices, but the definition of the market and the index is an open question. As Bartholdy et al. (2007) note, most of the empirical data for event studies is coming from a single source:

the Center for Research in Security Prices (CRSP), which includes data of US stocks and indices. For event studies of companies listed in US it is natural to choose an index from US markets, but for other countries or in multi-country setting the choice is not so clear. A straightforward choice would be to choose the stock market index of the market where the event company is listed, but exceptions for this could be if the company has most of its operations somewhere else, if the home country stock market is very small with a high variance or if the events involve companies in multiple countries. To answer the multi-country event study problems Park (2004) developed a world market model that considers the event company home market index return, world market index return and change in exchange rate as the components for the overall stock return. Examples for suitable world market indices are the EAFE (The Europe, Australia, Far East) index or FTSE (Financial Times Stock Exchange) World Index. According to Park (2004) the use of world market model resulted in less overestimation of abnormal returns than traditional market model in a case of events that involved companies in many countries.

Besides the geographical choice of a market index, one stock market can present multiple indices. For instance the S&P500 index has three general versions: value-weighted, equal-weighted and dividend index (Standard and Poor's Financial Services LLC 2011). In event study literature the difference of equal-weighted and value-weighted indices has been analyzed in a couple of occasions. Value-weighted index has been seen to reflect the market performance most accurately, thus is should be used in event studies (Roll 1981; Ohlson & Rosenberg 1982). Interestingly, the usage of value weighted index results in higher percentage of falsely rejected null hypothesis than equally weighted index. In other words, equally weighted index detects abnormal returns more likely, but still it should not be used.

All in all, the step of calculating abnormal returns does not go through the same pattern as there are dozens of methods, variables and data sources to use. Risk-adjusted regression models are dominating the event study literature and from the regression models SIMM is the most common model mainly because of its simplicity and robustness with different research design issues (Henderson 1990). Special situations such as unavailability of past data or multi-country setting require adaptation of the abnormal calculation methods. Similarly to the phases of setting event window lengths and controlling confounding events, documenting the exact procedure is essential. An assumption that only the name of the model will explicitly indicate abnormal return model details is obviously too bold. For example Meznar et al. (1994) describe the calculation quite vaguely as “calculating a regression line to fit the stock prices of the firm several months preceding the event date, with the overall performance of the stock market controlled”. In this case there is no mention of how many and what regression parameters are used and how the stock market is controlled. Describing the method in detail improves the credibility and replicability of the study.

Nothing prohibits a researcher from using multiple normal return models in a same research. This approach is used by Adams et al. (1999): the abnormal returns are calculated using mean-adjusted model, market-adjusted model and single-index market model. This way the robustness of different models in the particular study is checked. In multiple-model studies it is important to explain if models produce divergent results and validate which result is the most plausible.

3.5. Reporting relevant test statistics

McWilliams and Siegel (1997) defined step six as the step in which to compute abnormal returns and test their significance. In their seventh step the significance is tested more thoroughly with binomial Z or Wilcoxon test statistic. In this chapter both of these test phases are combined to describe the event study significance tests in general. Similarly to previous steps, the practice of statistical significance testing in event study literature is highly diverse. The eighth step of event study procedure is to use bootstrap methods and discuss impact of outliers if the event study sample is small. This conditional step is also discussed in this chapter.

The division of significance analysis to sixth and seventh step is also a division between the major assumptions in event study result analysis: are the abnormal return distributed normally or not? In the sixth step McWilliams and Siegel (1997) are testing the significance with the normal distribution assumption. From the standardized cumulative abnormal returns the null hypothesis rejection probability can be calculated with methods demonstrated by Campbell et al. (1997, p.161). After the p-value is calculated, the researcher has to make a choice whether to use one-tailed or two-tailed test. Testing abnormal returns is usually done two-tailed, because both negative and positive abnormal returns are potential results (for example Klein & Rosenfeld 1987; Worrell et al. 1991; Adams et al. 1999). Bowman (1983) notes that if the direction of a stock effect is predicted, a one-tailed test would be suitable, but this hasn't been followed much in researches, maybe because the directionality prediction is not certain and two-tailed test brings extra confidence to the results.

Reporting two-tailed p-values for each abnormal return result is almost a standard, but it lacks the ability of identifying outliers that could skew the results. The OLS estimation method used in market parameter estimation is particularly sensitive to outliers, making the whole result sensitive to them. Small sample of companies and events increases the impact of outliers, so it becomes crucial to evaluate whether the results are skewed by outliers. Options for the treatment of outliers are either to remove them from the sample or to report nonparametric test statistics. Non-parametric test statistics do not require normal distribution of the data set, which makes them usable in small samples (McWilliams & Siegel 1997)

Non-parametric tests that have been used widely in event study include positive (or negative) proportion of sample size, binomial Z and Wilcoxon signed-rank test. Basically, they are examining the same sample characteristic but in a different depth. The statistic of positive proportion of sample size simply calculates how many of the individual abnormal return observations yield a positive result (Nayyar 1995; Klassen & McLaughlin 1996). Null hypothesis would mean that half of the abnormal return observations are positive and half are negative, or if the returns of a company are suspected not to be equally divided, the distribution can be determined from the estimation period (Lee 2001). Even this simple test can reveal new details of the sample: for example if a parametrically significant mean positive abnormal return is dominated by only a few large abnormal return observations on the positive side, but most of the observations are slightly on the negative side, the significance of the original result is disputed. Compared to proportion test, binomial Z test (or sign test) makes the simple positive (or negative) proportion statistic more quantitative. It relates the proportion of negative or positive returns to the sample size, giving a Z-value that is used to detect the statistical significance level of the analyzed proportion (McWilliams & Siegel 1997). Wilcoxon signed-rank test goes a step further: besides the sign of a single abnormal return observation Wilcoxon signed-rank test takes into account also the size of the abnormal return observation (Tsetsekos & Gombola 1992; Burton et al. 1999). In the test the absolute values of abnormal returns are ranked with positive from lowest to highest, so the highest absolute abnormal return gets the same rank as the sample size is. After ranking the abnormal returns, the original positive or negative sign is re-attached to the rank and the sum of all ranks is calculated. The resulting sum is Wilcoxon W, which in turn is converted to Z-value and finally to the significance level of the abnormal return sample (Lowry 2011). These three tests are not mutually exclusive, so it can be useful to employ at least two of the nonparametric tests (for example Koh & Venkatraman 1991; Lee 2001).

Eighth step of McWilliams and Siegel's (1997) event study procedure is also related to statistical processing of results. Authors are noting that the step only concerns a sample of fewer than 30 companies, but justification for exactly that number are not given. The additional tasks for small samples include usage of bootstrapping technique and discussion of outliers' impact to the results. Bootstrapping is a technique for estimating unknown quantities in statistical models and it is used to find standard errors for estimators, confidence intervals for unknown parameters or p-values for testing null hypothesis (Boos 2003). McWilliams and Siegel (1997) suggest using bootstrap technique to report probability values of test statistics that are not requiring normality assumptions. They criticize past event studies for not reporting any bootstrap test statistics, but the situation has not changed after the article and it is difficult to find even one event study with a mention of bootstrapping techniques. Therefore, the usefulness of bootstrapping remains ambiguous.

4. RESEARCH METHOD AND MATERIAL

4.1. Case companies

The sample companies were not identified as in usual event study. Instead, the two sample companies, Outotec Oyj and FLSmidth Co. A/S, were preselected for the purposes of the background project. Small amount of companies can be a minor error source for the parametrical statistical significance tests because the results can have skewness and kurtosis (Brown & Warner 1985). Controlling non-normality of the distribution is treated later in the methodology description along with other statistical significance tests. The approach in this study is very case-like which creates other additional requirements to the selection of companies because usually event studies are aimed for a wider set of companies (Brown & Warner 1985; MacKinlay 1997). For example the industry and the size of companies are recommended to be controlled to limit the sources of deviation in final results. For these reasons some relevant background information and financial information about the two focal companies are presented next to control the effect of unknown factors.

4.1.1. Outotec

Outotec Oyj is a global company specialized in minerals and metals processing technology. It is headquartered in Espoo, Finland and it has been listed in NASDAQ OMX Nordic Helsinki Stock Exchange (OMXH) since 10th October 2006. The stock symbol of Outotec is OTE1V. Earlier Outotec was the technology business unit of a mining and metals corporation, Outokumpu Oyj, but it spun off Outokumpu in 2006 to form Outokumpu Technology Oyj, which, in April 2007, changed its name to Outotec Oyj. (Outotec Oyj 2011c)

The revenue of Outotec consists of technology expertise, technology transfer packages, licensing, plant sales and equipment sales to minerals and metals industry. Turnover reached 969,6 million euros in 2010 with an operating profit of 74,7 million euros. Outotec is divided into three business areas and the biggest business area in terms of sales in 2010 was Non-ferrous Solutions constituting 64% of Outotec's total sales and 41% of total operating profits as presented in Figure 3 and Figure 4. Outotec also lists services as a separate business area, but service sales are included in the sales figures of other business areas. (Outotec Oyj 2011b)

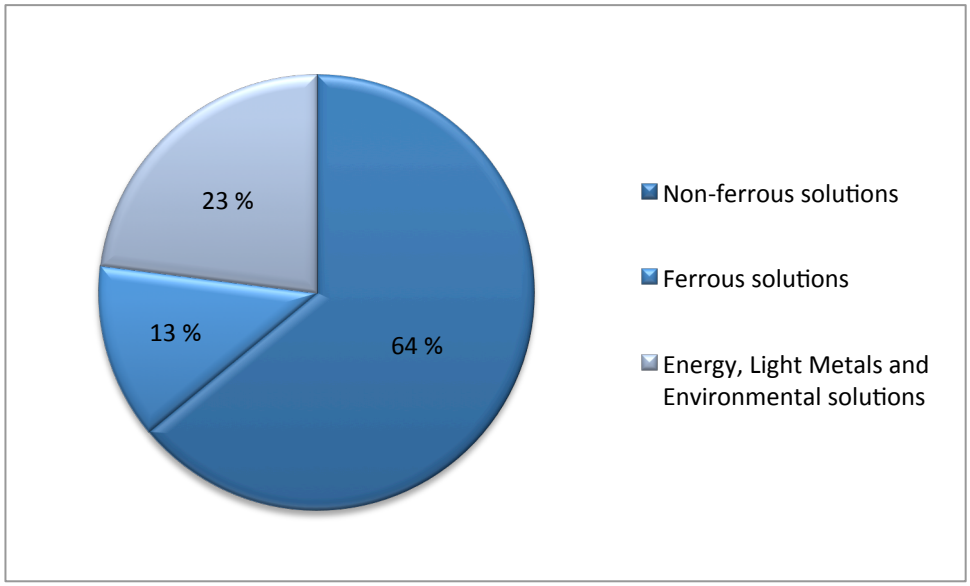

Figure 3. *Sales of Outotec Oyj by business area (adapted from Outotec Oyj 2011b)*

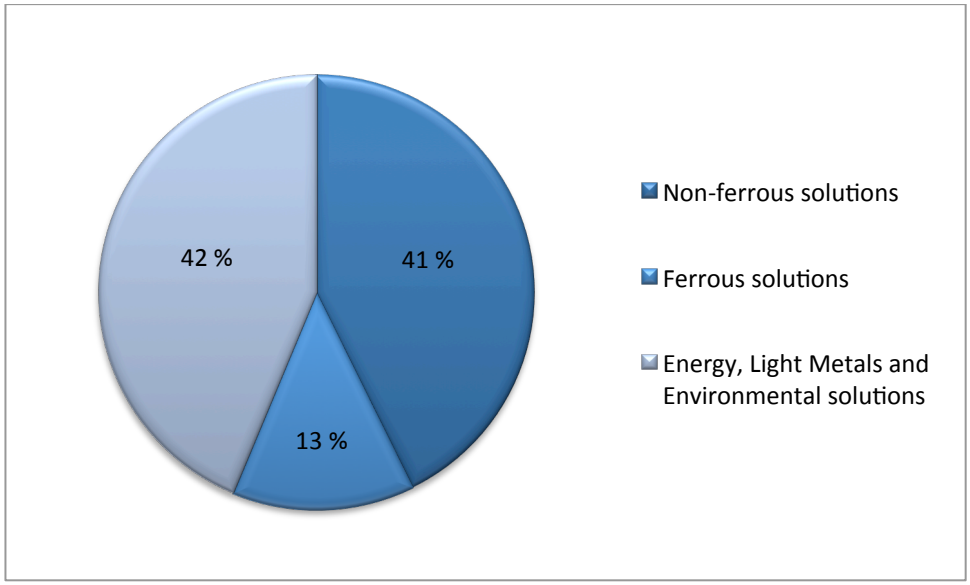

Figure 4. *Operating profits of Outotec Oyj by business area (adapted from Outotec Oyj 2011b)*

Comparing the two figures we can see that Energy, Light Metals and Environmental solutions is the most profitable business area while Non-ferrous Solutions has the lowest sales margin. This observation is essential in the comparison of the economic impact of received orders by business area.

The business area of Non-ferrous Solutions is composed of businesses relating to the processing of copper, nickel, zinc, lead, gold, silver, and platinum group metals. Outotec offers solutions to the entire value chain from ore to pure metal. The scope of projects varies from single proprietary equipment to full-scale plants with long service contracts. The Ferrous Solutions business area offers same kind of value chain variety than the Non-ferrous Solutions, but in only consists of projects related to processing of

iron and ferroalloys. The Energy, Light Metals and Environmental Solutions business area is a variety of technologies bundled under the same business area. The technologies in the business area include energy production methods focused on efficiency and cleanliness (renewable energy, oil shale, oil sand), alumina, aluminum, and other light metal production and environmental solutions such as sulfuric acid plants, heat recovery and wastewater treatment. Outotec also separates the business area of Services in its annual review, but the sales volume of services is included in three other business areas. (Outotec Oyj 2011b)

Regarding received order contracts, Outotec has had quite solid order backlog since its separation from Outokumpu Oyj. Order backlog has not been on constant increase, instead it has fluctuated yearly between 866,4 million euros and 1393,1 million euros. (Outotec Oyj 2011b) Outotec's biggest single contract before 2011 was a sulphuric acid plant in 2007 which had a contract value of 270 million euros (Outotec Oyj 2007). The five smallest contract values that Outotec has published in its press releases have been from 6 to 10 million euros (Outotec Oyj 2010). Outotec (2011a) states it discloses "such orders received, which significantly deviate from Outotec's daily normal business operations either by exceptional value or magnitude". In this case it presumably means non-disclosure of contracts with a value from 0 to 5 million euros.

4.1.2. FLSmidth

FLSmidth Co. A/S defines itself as "a leading supplier of equipment and services to the global cement and minerals industries" (FLSmidth 2011b). FLSmidth has its headquarters in Copenhagen, Denmark and it is listed in NASDAQ OMX Nordic Copenhagen Stock Exchange (OMXC) with the stock symbol FLS. FLSmidth was founded in 1882 as an engineering consulting company and since the beginning its core activity was selling cement manufacturing technology. In late 1980s FLSmidth started to diversify into other business areas and when the millennium changed, it already had a strong foothold in minerals industry, competing in the same area with Outokumpu Technology, later Outotec Oyj. (FLSmidth 2011c)

The turnover of FLSmidth in 2010 was 2700 million euros and the year ended with an operating profit of 171 million euros. FLSmidth divides its business into three business areas: cement, minerals and Cembrit. In terms of sales, the business areas of cement and minerals are almost equally sized representing 93 percent of total sales (Figure 5). Profits are divided in a similar fashion, with an exception of lower profitability in Cembrit business, contributing only 1 percent of total EBIT (Figure 6). (FLSmidth 2011a) The figures show that profitability of Cement and Minerals business areas are in effect identical. Thus, profit-wise the impact of orders received from these business areas should be the same.

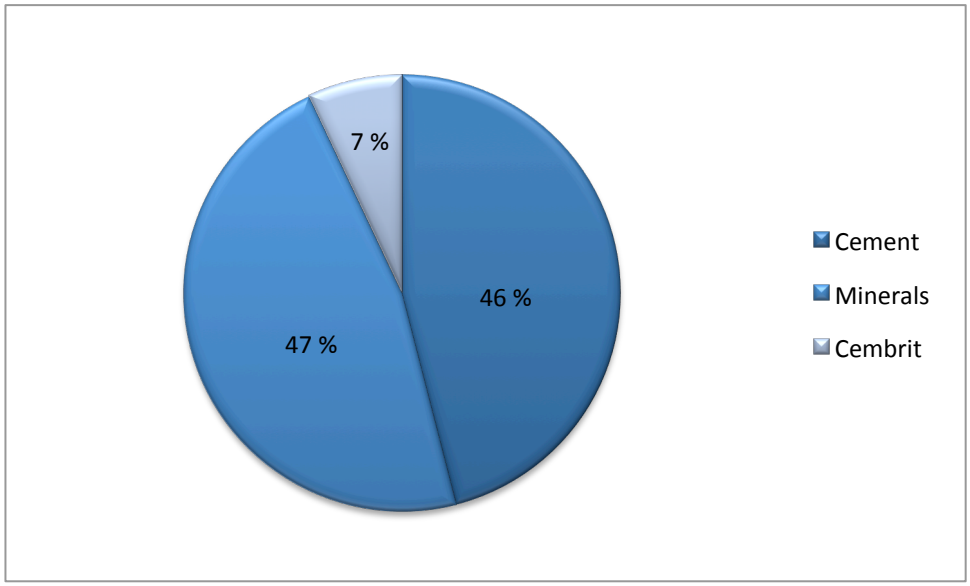

Figure 5. *Sales of FLSmidth & Co. A/S by business area (adapted from FLSmidth 2011a)*

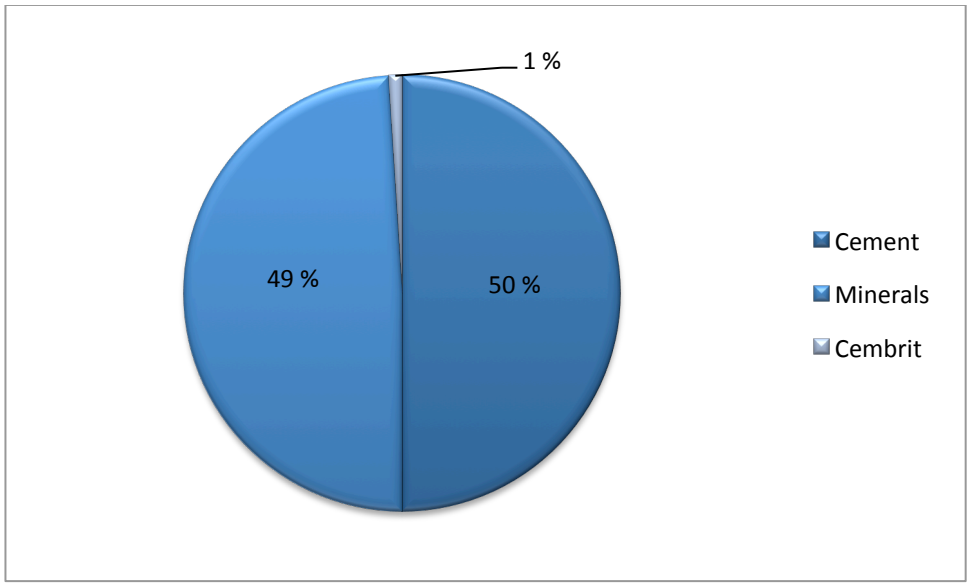

Figure 6. *Operating profit of FLSmidth & Co. A/S by business area (adapted from FLSmidth 2011a)*

The business area of Cement comprises of FLSmidth's cement technology all the way from complete cements plants to spare parts and cement production know-how. FLSmidth is the market leader in contracted cement kiln capacity with its 38 percent market share. As Outotec doesn't operate in cement business, the two case companies are not competitors in this particular business area. Instead, FLSmidth competes with Outotec in the Minerals business area, where FLSmidth is active in supplying customers with equipment for mining, processing and transportation of various different minerals. FLSmidth is also aiming to be a full value chain system supplier, so the competition with Outotec is strong in many projects. The third business area, Cembrit, concentrates on fiber-cement products for building materials industry. (FLSmidth 2011a)

Order backlog of FLSmidth has followed somewhat same pattern as Outotec's: it has ranged from 2,3 billion euros to 4,2 billion euros between 2006-2010, decreasing in 2009 (FLSmidth 2011a). The most valuable single contract before 2011 has been the delivery of the world's largest cement plant in February 2006, totaling 206,7 million euros (FLSmidth 2006). The smallest contract value that FLSmidth has disclosed is 13,4 million euros (FLSmidth 2009). FLSmidth doesn't elaborate on its website about the disclosure policy, but the lower limit of disclosed orders appears to be around 10 million euros. A special characteristic of FLSmidth's press releases is the disclosure of contract rumors. They are press releases announcing a contract that has been signed but is still unbinding i.e. the customer hasn't made prepayment. This convention is probably originating from a suspected violation of a principle of disclosure in 2007, where FLSmidth failed to disclose an unbinding contract before a journalist found out about the contract (FLSmidth 2010).

4.1.3. Comparison of case companies

Some of the key figures of the two case companies are compared in Table 2 to give a general idea of the similarities and differences between the companies. Presented figures are yearend average values between 2006 and 2010, unless stated otherwise.

Table 2. *Outotec Oyj and FLSmidth Co. A/S comparison of key figures (yearend average values between 2006 and 2010)*

	Outotec Oyj	FLSmidth Co. A/S
Revenue (millions of euros)	961,2	2711,4
EBIT (percentage of revenue)	7,50	8,92
Net income (percentage of revenue)	5,62	7,02
Order backlog (millions of euros)	1124,2	3196,6
Book-to-bill ratio[2]	1,17	1,21
Market capitalization (millions of euros)	1242,1	2796,6
Book-to-market ratio	0,91	1,08
Earnings per share (euros)	1,32	3,53
P/E-ratio	30,8	15,7
Dividend payout ratio	68,1%	24%

[2] Book-to-bill ratio is the size of order backlog divided by revenue of the same period

The figures show that the scale of activities in FLSmidth is three times larger than in Outotec, but operationally the companies are in a same kind of situation with their similar levels of EBIT and their 5-year average book-to-bill ratio slightly over 1. Stock ratios show some differences in the profile of stocks: Outotec is a high dividend payer but at the same time more expensive based on higher P/E-ratio. In chapter 2.3 it was described how company's book-to-market ratio and market capitalization systematically affect stock returns. The comparison shows that the case companies book-to-market ratios are very close to each other and despite FLSmidth's almost double-sized market capitalization compared to Outotec, the companies are of the same order if examined in Nordic-wide context. Among the 564 companies listed in stock exchanges of Helsinki, Stockholm and Copenhagen, FLSmidth has the 63rd largest and Outotec the 90th largest market capitalization (based on values on 30th September 2011). This comparison gives support to the argument that the stock price reaction is comparable between the two companies, as companies are competitors in the same industry and do not show fundamental differences.

4.2. Data and event window selection

The event date data is gathered from internet-based sources. For Outotec Oyj the press release archive maintained on the company website was manually examined and announcements regarding order contracts were saved for further usage. The preliminary classification yielded 74 press releases with dates ranging from 11th October 2006 to 21st December 2010. Older press releases are found from the archive, but because Outotec separated from Outokumpu and listed to stock exchange as its own entity on 1st of October 2006, press releases before that date are omitted. The time stamps of announcements were cross-checked with the stock announcement archive of Nasdaq OMX Nordic to be sure there is no lag between Outotec website time stamps and stock exchange time stamps. Several time stamp inconsistencies were found because some announcements have been released in a different time zone, but the inconsistencies were corrected to match the CET+2 time stamp of Nasdaq OMX Helsinki announcement archive. For FLSmidth, the gathering of press releases was more automated. A search was made in LexisNexis news aggregation service with search terms that included FLSmidth as a company and newswires as a source. One particular newswire service was identified as the primary newswire for FLSmidth and the time stamps of the newswire announcements were cross-checked with the stock announcement archive of Nasdaq OMX Nordic to be sure there is no lag between newswire time stamp and stock exchange time stamp. Then the search results from LexisNexis were input into a semantic headline classifier, which automatically classifies news into different event categories. Finally, the results of automated classification were complemented, checked and corrected manually. This preliminary search yielded 94 press releases between 20th February 2006 and 10th December 2010.

The next step was to choose the length of the estimation window and the event window. Estimation window was chosen to be six calendar months with the assumption of 21 trading days per month. To avoid the contaminating effect of pre-announcement information leakage, estimation window ends 10 trading days before the event date. Therefore, the general estimation window, in trading days, is -126 to -10 days. The chosen estimation window is in line with the usual length and positioning of estimation window in event studies. For special cases in this study, such as longer than 20-day event windows, the adjustments to estimation windows are noted along with the results.

For the actual event windows, multiple different time frames are used to capture various aspects of the study. The longest event window is -20 to +20, and the purpose of this window is to show the general movement of stock price around the event and the significance of the shorter event windows in wider context. Other event windows range from -3 to +3 days. Event windows -1 to 0 and -1 to +1 are especially important, because they are expected to capture the largest part of stock reaction, if hypothesis of stock market efficiency holds. McWilliams and Siegel (1997) seek for justification for the usage of event windows longer than two days. In this study the mainly used event windows are the 1-day and 2-day windows, but the 6-day event window is to control short-range information leakage and to observe possible lag in investor reaction. Problems related to longer event windows such as controlling confounding events and lower statistical significance are noted (McWilliams & Siegel 1997). The 6-day event window is treated appropriately by searching confounding events of the whole 6-day event window and additional tests for significance are included.

After choosing the relevant time periods, the initial sample of events was checked to eliminate events that have missing data or confounding events in their event windows. Firstly, the events of Outotec between October 2006 and March 2007 were eliminated because of missing stock data needed for 6-month estimation window. Then, confounding events for Outotec and FLSmidth were checked by manually scanning through all press releases to find significant events around order contracts. The classification for confounding and non-confounding events was strict, regarding only very minor announcements to be non-confounding. These minor announcements included for example invitations to quarterly Q&A session, minor changes in shareholding or recognition of small-scale CSR issues in trade fairs. The events that are undoubtedly confounding include the event types listed in chapter 3.3. The full list of events and filtered list after controlling missing data and confounding events are supplied in Appendices 1 and 2 The initial sample of 173 events narrowed down to 111 clean events for event window -1 to +1 and 55 clean events for event window -3 to +3.

The details of the events in clean event sample were examined further to facilitate the building of regression models. For each event the size and contents of order contract was searched from the press release and listed if found. Based on the technological content, orders were classified into subcategories of different business areas. The size of

the order contract or the technology was not always mentioned in the press release, resulting in slightly smaller samples for regression analysis. An important detail of the announcement policy of FLSmidth is announcing the order contract rumors. The outline of these rumor announcements and possible reason for the practice is elaborated in chapter 4.1.2. Because contract rumors appear to materialize in every case in the sample, they are considered to be significant contract announcements. The official announcement which the rumor concerns is also taken to the sample, so in other words the total effect of these pre-rumored contracts is diluted between the rumor announcement and the actual order announcement. In addition, there are two cases, one for each company, where two order contracts are announced during the same trading day. In both cases the business area of the two contracts is the same, so the order sizes are summed and they are treated as one contract. Table 3 summarizes the elimination criteria and sample sizes for each category.

Table 3. *Event study sample sizes*

Elimination / Classification criterion	Outotec		FLSmidth		Total	
Full sample	74		99		173	
	-1 to +1	-3 to +3	-1 to +1	-3 to +3	-1 to +1	-3 to +3
Clean of confounding events	44	19	67	36	111	55
Order size announced	38	15	57	30	95	45
Outotec business area:						
-Ferrous Solutions	9	9	N/A	N/A	9	9
-Non-ferrous Solutions	25	6	N/A	N/A	25	6
-ELE[3]	9	3	N/A	N/A	9	3
FLSmidth business area:						
-Cement	N/A	N/A	41	26	41	26
-Minerals	N/A	N/A	26	10	26	10
-Cembrit	N/A	N/A	0	0	0	0

In addition to the amount of events, the characteristics of event sample are described in a few figures to get a better idea of the composition of the event sample. One very important figure is the ratio between the value of announced order contracts and the total sales of the company from 2006 to 2010. The larger the ratio, the more

[3] Energy, Light Metals and Environmental solutions

representative is the event study sample of companies' business in general. For Outotec the representativeness is on a quite good level, as the announced order contracts contribute over 50% of total sales. The same ratio for FLSmidth is somewhat lower, so that the publicly announced order contracts comprise only about one third of total sales (Table 4). Because the policy of the minimum size of order contract to be announced publicly is basically same in both companies (10 million euros), the lower ratio in FLSmidth can be interpreted as a larger proportion of small inward cash flows such as service contracts. Another major characteristic is the size scale of announced contracts. Average value of order contracts in full sample for Outotec is 43,1 million euros and for FLSmidth 54,8 million euros. This difference is also visible in order quartile values, where Outotec's order values are constantly on a lower level, especially in small-sized orders.

Table 4. *Event study sample characteristics*

	Outotec Oyj	FLSmidth Co. A/S
$\frac{\text{Total value of order announcements}}{\text{Total sales}}$	0,54	0,35
Average order contract value (MEUR)	43,1	54,8
- Confounding events cleaned +- 1 day	44,2	55,9
- Confounding events cleaned +- 3 days	57,0	57,5
Order contract values		
-Minimum value	6,0	13,4
-1st quartile	17,0	31,2
-2nd quartile (median)	25,0	43,0
-3rd quartile	46,5	63,5
-Maximum value	270,0	206,7

Besides event data, the gathering of stock and market data is an important step of event study. Analyzed stock data is daily adjusted closing price data. Stock data source is Nasdaq OMX database, where adjusted daily closing data is freely available. The representative market data for Outotec and FLSmidth are market performance indices of Nasdaq OMX Helsinki (OMXHPI) and Nasdaq OMX Copenhagen (OMXCPI) respectively. Because the literature strongly supports the use of value-weighted market index instead of equal-weighted market index, the former is used. Index data was also gathered from freely available Nasdaq OMX database. If either stock data or market data was missing from a particular day the reason for the missing data was attempted to be pinned down. For almost all of these cases the reason was incorrectly logged non-trading day market data. In couple of instances stock data was missing, but the missing days didn't overlap with any event windows. For the regression analysis examining fifth hypothesis, the monthly inflation levels converted to yearly inflation percentage were

collected from Eurostat for Finland, Denmark and European Union (Figure 7). For each event the inflation level of the event month is searched and added to the data. Eventually, the resulting table of events includes five columns for each event: event timestamp, company (Outotec or FLSmidth), order contract value in euros, business area of the order contract and inflation level of the event month.

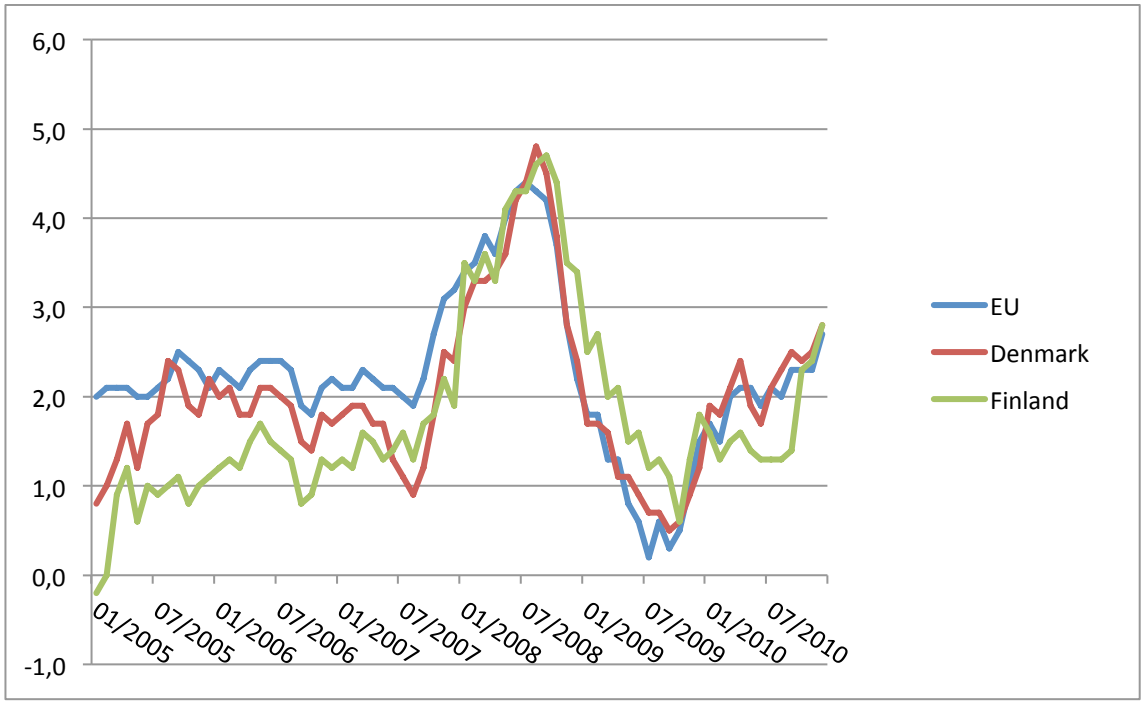

Figure 7. *Monthly inflation data (as yearly values) for European Union, Denmark and Finland (Eurostat)*

The used stock returns are converted from the adjusted daily closing prices to daily return percentages using continuously compounded (or logarithmic) return calculation. The return levels are input to the estimation and abnormal return calculation model as unitless quantities, for example 4 percent as 0,04. Thus, the abnormal return results are output in the same way.

4.3. Abnormal return calculation method

A wide range of abnormal return calculation methods is presented in chapter 3.4. From the presented methods the prevailing method in event study literature, single-index market model or SIMM, is selected for this event study for various reasons. Because of the limited sample size the detection of abnormal returns could pose a problem in this research, so the methods with fundamentally lower abnormal detection rate such as mean-adjusted return model and market-adjusted return model are rejected. Although the market adjusted return model would have enabled longer sample period because the initial stock listing of Outotec would not cause a 6-month gap, the abnormal return detection is still a priority. Regarding multiple index models, there is some literature supporting the usage of industry indexes in industry-limited studies (MacKinlay 1997),

and the company sample of this thesis can be seen very concentrated industry-wise. Still, an industry index for the case companies is hard to define. At first glance a mining industry index (for example FTSE 350 Mining) might seem representative, but it covers only about a half of FLSmidth's customers: the business area of minerals. An index for technology solution companies such as FLSmidth and Outotec was not found. The notion of world market model introduced by Park (2004) is acknowledged but not applied because this study is not a full scale multi-country event study as Park describes it, but a two-country event study setting where results of the different countries are treated separately. The problem for applying three-factor CAPM is that the additional factors are only calculated for US markets, rendering the model inaccurate for Nordic markets. Generalizing for this study, all the multiple index models have too much uncertainty compared to the additional explaining power of the models, so the usage is not justified.

More precisely, the usage of SIMM model in this study follows the formulas presented by Campbell et al. (1997, pp.158-163). Following the timeline in Figure 2, event day is defined to be $\tau = 0$, estimation window length $L_1 = T_1 - T_0$ and event window length $L2 = T_3 - T_2$. A special remark of the notation of time windows in this event study is that closing prices of each day are used to represent the daily stock returns. This means that the event day return is captured between closing prices of day -1 and day 0, thus the notation -1 to 0 days means the event day, 0 to +1 days means one day after the event day etc. The market model return parameters are estimated as a regression system is

$$\boldsymbol{R}_i = \boldsymbol{X}_i \boldsymbol{\theta}_i + \epsilon_i \qquad (16)$$

where $\boldsymbol{R}_i = [\, R_{iT_0} + 1 \ldots R_{iT_1} \,]'$ is an ($L1$ x 1) vector of stock's estimation windows returns, $\boldsymbol{X}_i = [\, \boldsymbol{\iota}\ \boldsymbol{R}_m \,]$ is an ($L2$ x 2) matrix with a vector of ones in the first column and the market return observation vector $\boldsymbol{R}_m = [\, \boldsymbol{R}_{mT_{0+1}} \ldots \boldsymbol{R}_{mT_1} \,]$ in the second column. The vector $\boldsymbol{\theta}_i = [\, \alpha_i\ \beta_i \,]'$ includes the estimation parameters of SIMM. The OLS estimation is performed following the method of Campbell et al. (1997) and the OLS parameters are used to achieve abnormal return vector for each event. Abnormal returns vectors are aggregated and cumulated over time as in chapter 4.4.3 of Campbell et al. (1997).

4.4. Analysis of statistical significance and sensitivity

The analysis of statistical significance must be especially careful in this study because the sample size is smaller than generally in event studies. Besides calculating the actual cumulative abnormal return, the results are also parameterized by standard deviation for parametrical test statistics purposes. Campbell et al. (1997, pp.161-162) give two different ways of testing the abnormal returns against null hypothesis, although the results are not expected to be sensitive to the choice. In this study the one with equal weighting of the individual standardized cumulative abnormal return observations is used (1997, p.162). The parametric p-values are calculated with the formula

$$J_2 = \left(\frac{N(L_1 - 4)}{L_1 - 2}\right)^{½} \overline{SCAR}(\tau_1, \tau_2) \overset{a}{\sim} N(0,1) \quad (17)$$

where J_2 equals the p-value of standardized cumulative abnormal return from τ_1 to τ_2. This formula can also be used for results that are aggregated over securities.

In addition to parametric tests, a well-executed event study needs to have non-parametric tests. In this study, the Wilcoxon signed-rank test is used because it considers also the size of abnormal return observations thus giving an in-depth view of the distribution of abnormal return observations around the value of zero. The procedure of calculating Wilcoxon p-value in this study is the following (Lowry 2011):

1) The absolute value of each abnormal return observation of the sample is taken
2) The absolute values are ranked from lowest to highest, giving rank 1 to smallest value, rank 2 to second smallest etc. If two or more values are tied, the average of tied ranks is given to each tied value (for example if rank 7 and 8 are tied, both are given rank 7,5).
3) The original sign of the abnormal return observation is re-attached to the rank, resulting in an array of signed-ranks.
4) Signed ranks are summed. The sum is Wilcoxon W, symbolized as W.
5) Standard deviation of the sampling distribution W, σ_W, is calculated from

$$\sigma_W = \sqrt{\frac{N(N+1)(2N+1)}{6}} \quad (18)$$

and the z-value of Wilcoxon signed-rank test is

$$z = \frac{W - 0{,}5}{\sigma_w} \quad (19)$$

6) The z-value is converted to Wilcoxon p-value assuming standard normal distribution.

The Wilcoxon p-values are treated two-tailed in the same fashion as parametric p-values with significance levels 15%, 10% and 5%. When examining the significance of results the parametric p-value and the Wilcoxon p-value are compared and the less significant value is regarded to be the overall significance of a specific result.

The results can be sensitive to the selected estimation window. The sensitivity is tested by calculating some of the main results with three different estimation windows. The main window, -126 to -10 is compared to two other estimation windows: -42 to -10 days and -84 to -10 days. This is an important step to test the robustness of results in relation to estimation window length.

5. RESULTS

5.1. Results of hypotheses

5.1.1. Hypothesis 1: General reaction

The following results present the average abnormal stock return effect of order contract announcements in the two case companies during 2006 and 2010. The five hypotheses built on basis of theoretical background are examined one by one moving from more general hypotheses to the detailed analysis of abnormal returns.

> ***Hypothesis 1****: Investors positively react to the announcements of order contracts.*

First hypothesis is the most general one, examining only the existence and directionality of stock price reaction. The results for first hypothesis are divided into three: the general stock reaction (Table 5) and company-specific reactions (Table 6 and Table 7). For each category different lengths of event windows are tested to analyze the timing of the investor reaction. Investigating the full sample of events of both companies reveals that the stock reaction is positive as expected. The significant reaction (0,57% abnormal return) is perceived in event window -1 to 0, which means the reaction happens during the day of the stock market announcement. It is notable that if event window is lengthened even one day to cover the day after the announcement, the significance of stock reaction is heavily reduced because day +1 has a negative (but statistically insignificant) abnormal return. Besides the direction and intensity of the abnormal stock return reaction, the result suggests that no information leakage occurs at least three days before the event. Instantaneousness and brevity of the abnormal return effect demonstrates the economic approach through which the stock reaction is filtered through. The rational expectations approach does not seem prevailing because a significant reaction is found. Additionally, the myopic approach is not supported because reaction is quick; thus investors generally react according to neoclassical approach. Again, this interpretation does not imply that two other approaches are definitely wrong. For example, investor myopia can still occur in some strategic order contracts, but it is just not visible in the larger sample. Similarly, investors could have rational expectations of certain projects, but the majority of contracts are still new information to investors.

Table 5. *Outotec and FLSmidth abnormal returns, full sample*

Event window	n	Abnormal return	p-value	Wilcoxon p-value
-3 to +3	55	0,0011	0,93	0,87
-1 to +1	111	0,0025	0,41	0,47
-4 to -3	55	-0,0053	0,24	0,01***
-3 to -2	55	-0,0044	0,32	0,06**
-2 to -1	111	0,0003	0,98	0,76
-1 to 0	111	0,0057	0,05**	<0,01***
0 to +1	111	-0,0032	0,43	0,12*
+1 to +2	55	0,0012	0,94	0,92
+2 to +3	55	-0,0019	0,72	0,53

-P-values are two-tailed
* Significant at 15% level
** Significant at 10% level
*** Significant at 5% level

5.1.2. Hypothesis 2: Net income percentage

Second hypothesis examines the differences in abnormal returns between the two case companies. Compared to first hypothesis, which was concentrating on general market efficiency surrounding order contracts, the second hypothesis seeks to find out if the profitability of a company is a significant factor in average abnormal reaction.

> ***Hypothesis 2****: Stock price reaction to announced order contract is stronger (weaker) in a company with a higher (lower) net income percentage.*

The net income levels of Outotec and FLSmidth are, respectively, 5,62 percent and 7,02 percent (Table 2). The difference is not large and during some time periods the net income of Outotec has been slightly greater than FLSmidth's, but overall the stock price reaction of FLSmidth should be about 25 percent higher if the correlation is as straightforward as the hypothesis suggests. Factors that could skew the company-specific results are different inflation level, the significance of unannounced cash flows to company and the size difference of announced orders between companies. The effect of varying inflation level is assumed to be the same in both companies, because their inflation follows the same pattern (Figure 7) and they both have contracts evenly throughout the five-year period. The order size difference depicted in Table 4 shows

that the predicted higher abnormal return reaction of FLSmidth should be further boosted by size effect because the average order size is larger in FLSmidth.

The event study results give the similar direction of abnormal return effect that is hypothesized, but the magnitude of the effect does not fully support the second hypothesis. Table 6 and Table 7 exhibit the company-specific abnormal returns in various event windows. Outotec and FLSmidth have statistically significant abnormal returns on the event day, and the degree of abnormal return is practically the same in both companies: 0,57 percent for Outotec and 0,56 percent for FLSmidth. If the abnormal return percentage is converted to euro denominated growth in market capitalization (using year-end 5-year average in Table 2), the result can be interpreted more accurately. Average market capitalization increase caused by abnormal returns on event day for Outotec is 7,1 million euros and for FLSmidth 15,6 million euros, as the market capitalization of FLSmidth is more than two times larger than Outotec's. The theoretical average market capitalization increase per contract, calculated by multiplying the average order contract size by company's average net income percentage, is 2,48 million euros for Outotec and 3,92 million euros for FLSmidth. Thus, the actual stock price reaction is almost three times larger for Outotec and four times larger for FLSmidth compared to what the theoretical calculation suggests. This could be a sign for at least two things: investors generally regard contracts more valuable than what the price tag shows, for example seeing the contracts generating continuity to business and new opportunities in the future, or that the company-wide net income percentage is not a matching indicator with the profit margin of announced order contracts. For example, if the unannounced portion of company sales has a low profit margin, it has to be compensated in a greater margin of announced contracts. In this case the investors are presumed to be well aware of company profit and cost structure to incorporate the different profit margins to their reaction.

The company-specific results also show significant negative abnormal returns a few days before the event. For Outotec the 1,32 percent drop happens two days before the event and it is significant at 2% level. For FLSmidth the price drop happens three days before the event, it is 0,69 percent and significant at 5% level. The reason for these stock price slumps is unclear and without further evidence very hard to explain.

Table 6. *Outotec abnormal returns, full sample*

Event window	n	Abnormal return	p-value	Wilcoxon p-value
-3 to +3	19	-0,007	0,76	0,55
-1 to +1	44	0,0005	0,72	0,50
-4 to -3	19	-0,0022	0,47	0,45
-3 to -2	19	-0,0132	0,02***	<0,01***
-2 to -1	44	-0,0011	0,76	0,77
-1 to 0	44	0,0057	0,06**	0,06**
0 to +1	44	-0,0053	0,16	0,09*
+1 to +2	19	0,0056	0,43	0,34
+2 to +3	19	-0,0054	0,46	0,32

-P-values are two-tailed
* Significant at 15% level
** Significant at 10% level
*** Significant at 5% level

Table 7. *FLSmidth abnormal return, full sample*

Event window	n	Abnormal return	p-value	Wilcoxon p-value
-3 to +3	36	0,0053	0,69	0,80
-1 to +1	67	0,0038	0,17	0,23
-4 to -3	36	-0,0069	0,05**	0,01***
-3 to -2	36	0,0003	0,75	0,91
-2 to -1	67	0,0003	0,75	0,83
-1 to 0	67	0,0056	0,02***	0,05**
0 to +1	67	-0,0018	0,63	0,54
+1 to +2	36	-0,0012	0,47	0,32
+2 to +3	36	-0,0001	0,82	1,00

-P-values are two-tailed
* Significant at 15% level
** Significant at 10% level
*** Significant at 5% level

5.1.3. Hypothesis 3: Size of order contract

Third hypothesis requires approaching the raw results of the event study with other methods than previous hypotheses. Single events and their abnormal returns are treated as separate observations to build a model that links the size of the order contract and the abnormal return level to examine the third hypothesis.

> ***Hypothesis 3****: The positive abnormal return reaction is linearly correlated with the value of the order contract.*

To find the possible linear correlation the order contract size is regressed with abnormal return. Both companies are treated separately to filter out the company specific variance sources. The abnormal return of the order is defined to be the abnormal return between day -1 and day 0 because it was earlier noticed to be the only significant event window for both companies.

The regression graphs for Outotec and FLSmidth are exhibited in Figure 8 and Figure 9, and the regression statistics with ANOVA in Table 8. The regression result for Outotec is a rising line with slope of 0,00016. In the actual context it means 0,016 percent of abnormal returns per one million euro in order contract value. For example a contract with a value of 100 million euros should yield 1,6 percent abnormal return. This is a very rough result though, as the extremely low R^2-value reveals that much of the variance is not explained by this simple regression. Nevertheless, the significance of F shows that null hypothesis against the linear effect of order contract size to abnormal returns can be rejected on a 10 percent significance level. From Figure 8 it is perceived that the low-value order contracts have the highest variance in abnormal return level. Outotec states that it discloses "such orders received, which significantly deviate from Outotec's daily normal business operations either by exceptional value or magnitude" (Outotec Oyj 2011a), so the contracts with lowest price tags may include some intrinsic value such as breakthrough of new technology or entering new markets. This claim of implicit value of small-value contracts is supported by the results of running the regression again excluding order contracts below 10 million euros: R^2 is increased from 0,075 to 0,125. The negative outliers in low-value contracts still remain as question marks. One interesting result is the negative value of Y-axis intercept term. Of course it can merely be an estimation error, but if the result is interpreted straightforwardly, it means that announcing orders with value of less than 15 million euros is not advantageous for Outotec. Anyhow, this subject would definitely need more research to draw solid conclusions that could have managerial implications.

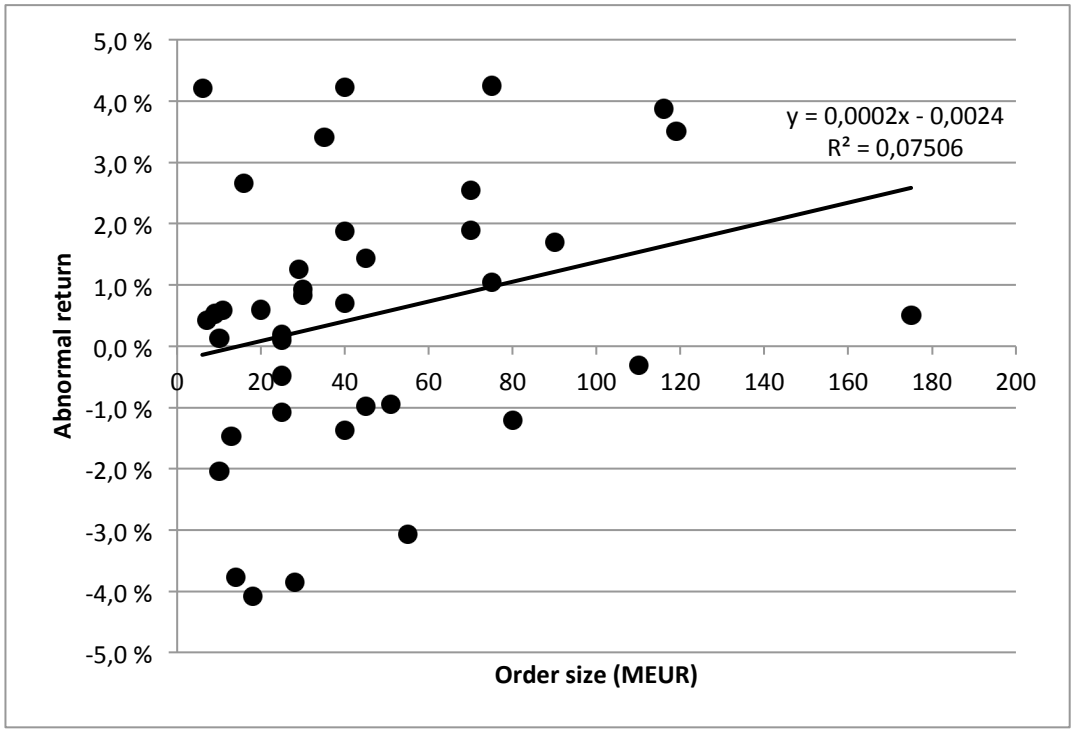

Figure 8. *Outotec order contract sizes regressed with abnormal returns*

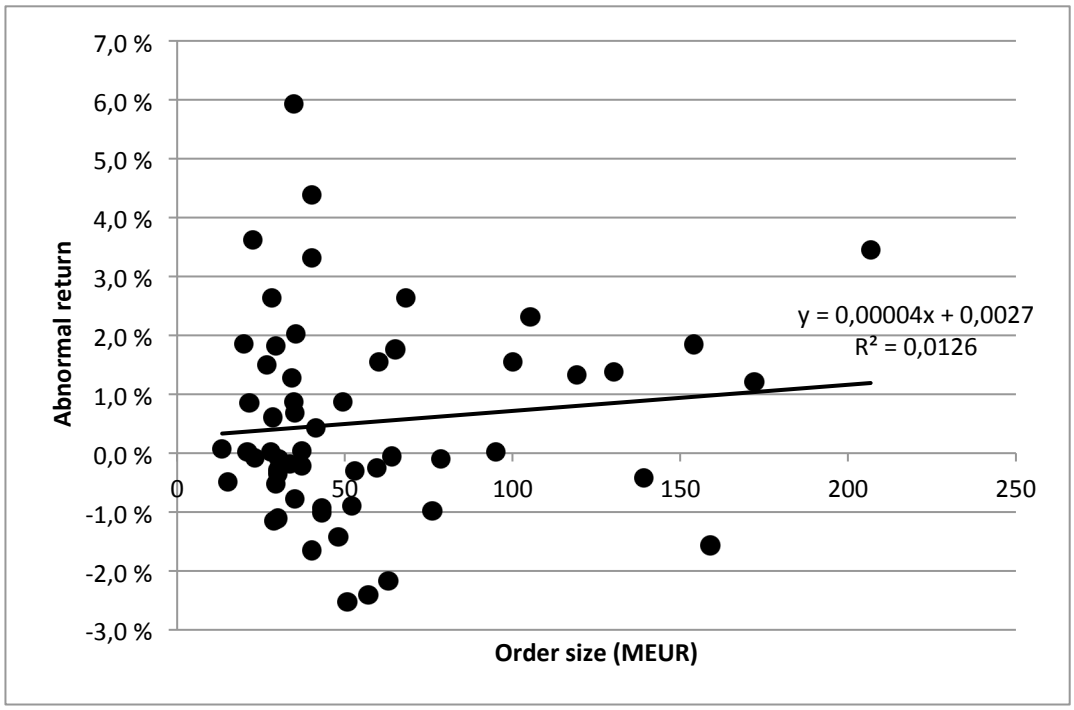

Figure 9. *FLSmidth order contract sizes regressed with abnormal returns*

Similar regression graph (Figure 9) for FLSmidth does not produce significant results. The slope of the linear regression line is minimal, R^2 is barely over 0,01 and significance of F is over 40 percent. Graph shows that especially in the order size region from 20 million to 50 million euros the variance of abnormal returns is huge. Using

only the size of order contract to build an explaining model of abnormal returns is a definite model misspecification in the case of FLSmidth. Therefore additional explaining factors must be sought.

Table 8. *Order size regression statistics and ANOVA*

	Outotec	FLSmidth
n	38	57
Multiple R	0,27	0,11
R^2	0,08	0,01
Adjusted R^2	0,05	-0,01
Standard Error	0,02	0,02
F	2,92	0,70
F significance	0,10	0,40
Y intercept	-0,0024	0,003
X variable (Order size)	0,00016 (p=0,10)	0,00004 (p=0,40)

5.1.4. Hypothesis 4: Business area

The fourth hypothesis is an additional explanatory variable for the abnormal returns. With the same theoretical logic that differentiated euro denominated company-specific abnormal returns, business areas with varying profit margins should also be valued differently by investors. The difference of stock reaction between business areas is analyzed with two separate methods: business area specific averages and multiple regression. Business area averages and their significances are exhibited in Table 9. Multiple regression with size and business area dummy variables is performed to both companies separately to test the fit of the regression model (Table 10). For a visual presentation the scatter plots with regression lines are presented in Figure 10 and Figure 11.

> ***Hypothesis 4****: The stock price reaction is affected by the operating margin of the business area to which the received contract belongs.*

Table 9. *Business area specific abnormal returns*

	Abnormal return					
	-1 to 0	p-value	-1 to +1	p-value	-3 to +3	p-value
Outotec: Non-Ferrous	0,0022	0,45	0,0004	0,81	-0,0028	0,92
Outotec: Ferrous	0,0066	0,32	-0,0148	0,28	-0,0191	0,46
Outotec: ELE	0,0101	0,21	0,0112	0,28	0,0175	0,62
FLSmidth: Minerals	0,0075	0,04***	0,0033	0,30	0,0255	0,17
FLSmidth: Cement	0,0044	0,15*	0,0042	0,30	-0,0024	0,70

-P-values are two-tailed
* Significant at 15% level
** Significant at 10% level
*** Significant at 5% level

Business area specific abnormal return results yield two results significant at 15 percent level. The two significant positive returns occur during the event day in both business areas of FLSmidth. The company sales and profit figures of FLSmidth (Figure 5 and Figure 6) show that the actual operating profit of Cement business area and Minerals business area are roughly the same. This is not consistent with event study results, where the abnormal returns of Minerals business is 0,75 percent but the corresponding figure for Cement business is 0,44 percent. The general stock price reaction between the business areas is much larger that the operating profit suggests.

None of the abnormal return results of Outotec are significant in parametric tests, but if the abnormal return values are nevertheless interpreted, the values of different areas correspond with actual business area profits. Comparing Outotec's sales and profit figures (Figure 3 and Figure 4) it is seen that Energy, Light Metals and Environmental Solutions is the most profitable business area, while Non-Ferrous Solutions is the least profitable. The same rank is visible in abnormal returns: ELE business area has an abnormal return level just over 1 percent and Non-Ferrous business barely over 0,2 percent, while Ferrous business area has abnormal return level close to company average. However, the non-significant p-values still indicate that abnormal return variance inside single business areas is too high to draw solid conclusions of business area effect to investor reaction. The variance appears to be especially high in ELE business area, where even 1 percent abnormal return is not significant whereas in FLSmidth 0,44 percent abnormal return is significant.

Table 10. *Order size and business area multiple regression statistics and ANOVA*

	Outotec	FLSmidth
n	37	57
Multiple R	0,20	0,17
R Square	0,04	0,03
Adjusted R Square	-0,05	-0,01
Standard Error	0,02	0,02
F	0,46	0,78
F significance	0,71	0,46
Y intercept	0,007	0,0001
X variable 1 (Order size)	-0,0001 (p=0,35)	0,00005 (p=0,29)
X variable 2 (Dummy 1)	0,003 (p=0,81)	0,004 (p=0,36)
X variable 3 (Dummy 2)	-0,004 (p=0,72)	N/A

Regression statistics and ANOVA indicate that business area dummy variables do not appear to be explaining factors of abnormal return variance. Compared to simple regression with only order size as a variable, the multiple regression with business area variables is not improving any of the goodness of fit statistics of Outotec. For FLSmidth the regression statistics remain in the same insignificant level as earlier. Results of multiple regression cannot be directly visualized, but if the different business areas are plotted to same graph, it gives an idea why the business area explanation is inaccurate. If the fourth hypothesis was true, the resulting graph would be parallel linear regression lines with their y-intercept value growing along with business area EBIT. The figures for both companies show that this not the case. For Outotec, the slope of order contracts in ferrous segment is ten times larger than the slope of non-ferrous segment. The slope of energy, light metals and environmental solutions segment is in between, but the observations for that segment are scattered all around (R^2=0,14). For non-ferrous segment the coefficient of determination is even lower (R^2=0,04). The ferrous segment has significantly lower R^2 (0,44), but the low amount of observations (n=9) in the segment makes the result questionable.

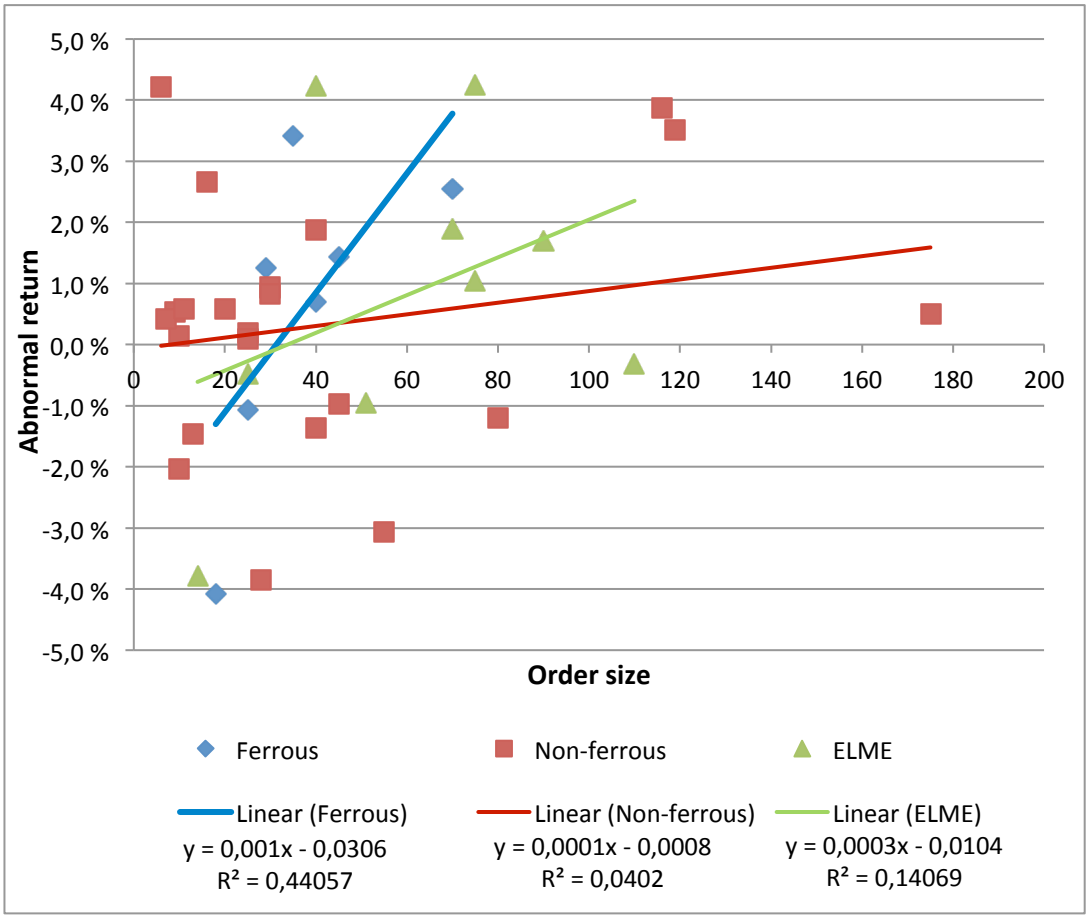

Figure 10. *Outotec regression with separate business areas*

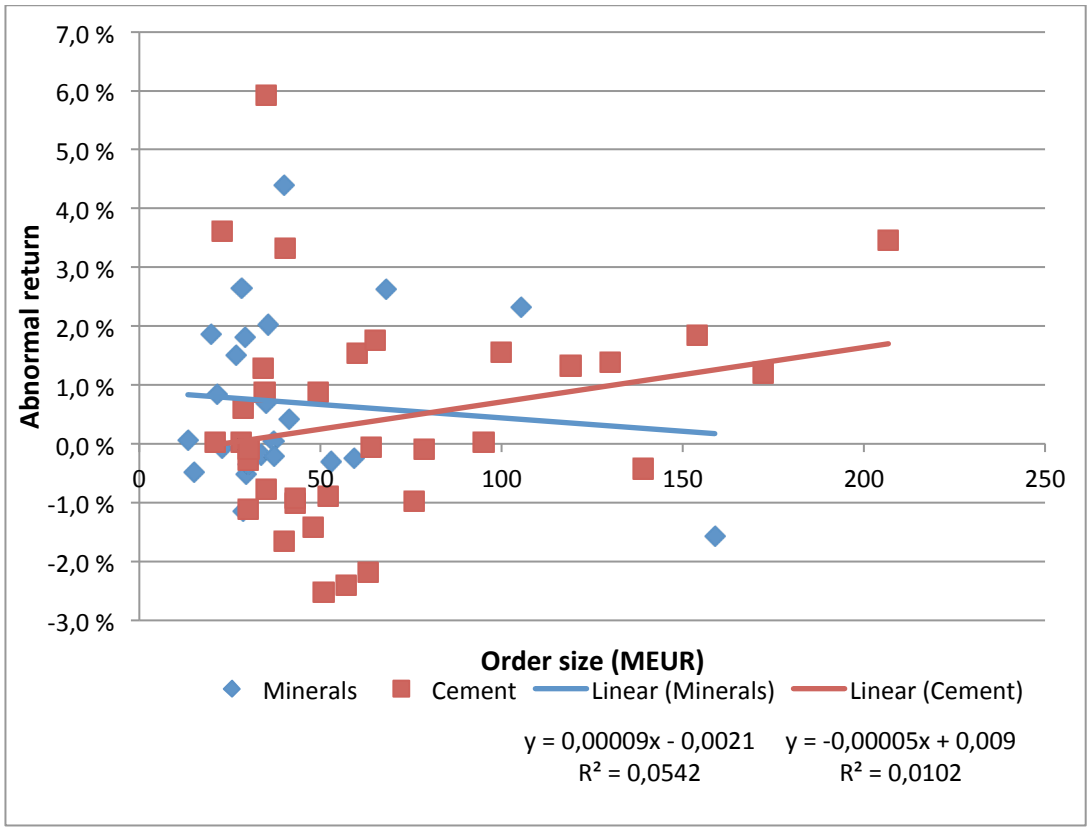

Figure 11. *FLSmidth regression with separate business areas*

The graph of FLSmidth reveals similar inconsistencies as the graph of Outotec. Conversely to the theoretical background the slope of minerals segment is negative meaning diminishing abnormal returns as order sizes increase. The significance of this result is very weak though, and the one negative outlier in high-value contracts is a major factor in turning the slope to negative value. The high variance of abnormal returns in order contract sizes between 20 and 50 million euros, noticed already in previous regression graph of FLSmidth, is also not explained by dividing observations into business areas, because other business areas have major outliers in the same region. Again, some other factors than business area are behind the variability of FLSmidth's abnormal returns.

5.1.5. Hypothesis 5: Inflation

The fifth hypothesis is examining the effect of macroeconomic variables to abnormal returns. If the hypothesis holds, it is a signal that investors can systematically valuate macroeconomic factors at least to some one-time events such as order contracts. The directionality of inflation effect is hypothesized to be negatively correlated, in other words when inflation is higher, the abnormal return is lower. Thus, the regression-based inflation variable should be negative.

> ***Hypothesis 5***: *The stock price reaction includes the effect of current inflation: during times of high inflation the order contracts are not valued as much as during low inflation.*

Business area dummy variables are omitted from this phase, because they were not found to be explaining factors during the analysis of fourth hypothesis. A multiple regression analysis is performed separately to both companies with two variables: order size and inflation level of the order announcement moment. Inflation level is input in the regression as raw number, not in percentages (for example 1% as 0,01). The regression statistics and ANOVA is presented in Table 11.

Table 11. *Order size and inflation level multiple regression statistics and ANOVA*

	Outotec	FLSmidth
n	38	57
Multiple R	0,32	0,26
R Square	0,10	0,07
Adjusted R Square	0,05	0,03
Standard Error	0,02	0,02
F	2,04	2,00
F significance	0,14	0,15
Y intercept	0,004	0,010
X variable 1 (Order size)	0,0002 (p=0,07)	0,00007 (p=0,20)
X variable 2 (Inflation)	-0,33 (p=0,29)	-0,35 (p=0,08)

Statistics show very similar values for the inflation variable for both companies. The sign of inflation variable is negative as expected. For FLSmidth adding the inflation variable to regression model has increased the significance of order contract size (p=0,20), but it still not significant at 10% level. FLSmidth's inflation variable itself is significant at 10% level (p=0,08). For Outotec the inflation variable is not significant (p=0,29), and even though in this model the significance of order size variable is increased compared to earlier results (p=0,07), the overall significance is not at 10% level (F significance = 0,14). The result implies that the investors of these two companies react to inflation level differently. For FLSmidth the reaction is systematical and significant, but for Outotec it seems not to be such a relevant factor.

5.2. Longer event window

In the results of second hypothesis, where company-specific abnormal returns were examined, one special observation was the significant negative abnormal return two to three days before the event. The results of the longest event window (-20 to +20 days) demonstrate this pre-announcement negative drift clearly (Figure 12). The sample used in producing the figure is the events of both companies with confounding events cleared from days -1 to +1. Thus, the event window is not clear of confounding events. However, the larger sample size reduces the effect of confounding events. The estimation window is adjusted to be from -126 days to -21 to avoid the overlap with

event window. The negative drift starts 13 days before the announcement and continues until the strong positive reaction on the event day. After day +1 the stock starts drifting upwards, reaching the same level as in day -13 at day +5. The daily abnormal return changes of the longest event window show how the event day abnormal return is the largest, but another major change happens on day +15.

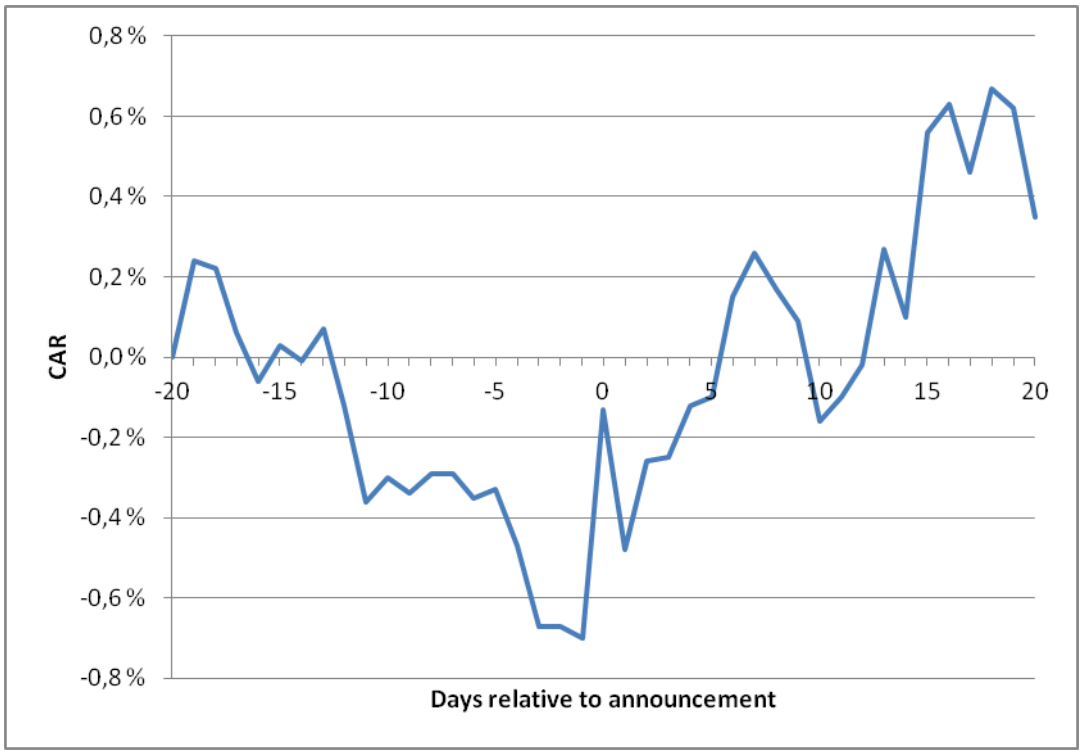

Figure 12. *Cumulative abnormal return (CAR) -20 to +20 days, both companies (n=111)*

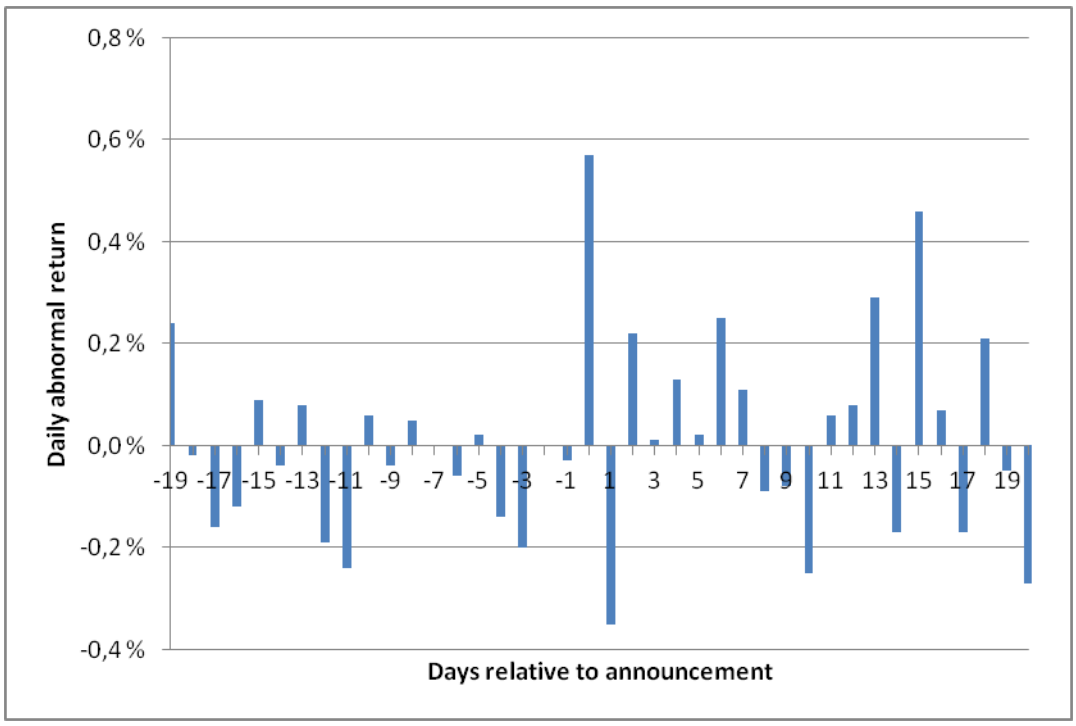

Figure 13. *Daily abnormal return change -20 to +20 days, both companies (n=111)*

The interpretation of the longest event window is not theoretically backed in this thesis as it is outside the built hypotheses. The graphs rather show the size of order contract reaction in a wider context and support the conclusion of the significant event day stock reaction. The negative pre-announcement drift is definitely an important phenomenon because it seems to "eat" the positive order announcement reaction two weeks before the announcement, but the explanation for the negative drift is yet to be determined. However, with this research setup the explanation is impossible to find out.

5.3. Result sensitivity and error sources

Sensitivity of the results as for the length of the estimation window is tested by running the abnormal return calculations with three different estimation windows. The significance level presented in Table 12 is based solely on parametrical p-value. Wilcoxon's signed-rank tests or further steps in the research, such as regression analysis, are not performed with the other estimation windows. Overall, the results with different estimation windows are not distinctly deviating. Most importantly, the longer estimation window does not produce results that are more significant than the results of shorter event windows. Thus, the original results give a conservative view of the abnormal stock reaction of announced order contracts.

Table 12. *Result sensitivity to estimation window length*

	Outotec			FLSmidth		
Estimation window length (days)	116	74	32	116	74	32
Abnormal return -1 to +1	0,0005	0,0015	0,0010	0,0038	0,0043**	0,0040**
Abnormal return -1 to 0	0,0057**	0,0061***	0,0056*	0,0056***	0,0057***	0,0057***
Abnormal return -3 to +3	-0,0070	-0,0032	-0,0058	0,0053	0,0055	0,0059

When possible error sources for the study are analyzed, the errors deepest in the method could be flaws in event study sample creation or in the abnormal return calculation method. The overall sample is chosen to be, rather unorthodoxly to event studies, only two companies. This creates methodological challenges that are partly tackled with the research design of the thesis, but some issues remain. Outotec and FLSmidth are competitors, which may imply that order contract reactions are mutually correlated. The similar effect that Hoffer et al. (1988) discovered to exist between automobile manufacturers' product recall announcements could be a significant factor also in this study, meaning that confounding events should have been checked also from the other

company. In case of Outotec and FLSmidth it is highly possible that the companies compete for the same projects and the success of the first means loss for the other. Another uncertain supposition of independency is behind the hypothesis that is examining inflation: for the regression analysis the order size and the inflation level are assumed not to be independent. In reality, the varying inflation could be a sign of same macroeconomic fluctuation that influences how big contracts customers are generally tending to sign. Thus, the independency assumption can be disputed.

For the event sample of FLSmidth one questionable detail is the way of handling event rumors. Treating the contract rumor announcement and the following official announcement as separate events, the effect of the event is split to two instances and the total effect is not accurately captured. Seven rumor-based pre-announcement cases occur in the largest sample of FLSmidth events so it is a slight drawback in accuracy. Another issue is the representativeness of the selected sample of company business as a whole. In FLSmidth this error is more possible, as the total value of announced order contracts represents only one third of total sales. For Outotec the same figure is about half of the sales. What the representativeness issue could cause is the misspecification of the profitability of announced order contracts. In the analysis of fourth hypothesis it is assumed that announced contracts have the same profitability than the business area as a whole. This assumption could be wrong, if the business logic is for example to sell the larger facilities with low margins and to gain profits later with signing multiple maintenance service contracts that are too low-value to be disclosed publicly. Different types of facilities could therefore have different levels of implicit profits that are expected to realize later in the life cycle of a product, and these are not shown in this thesis.

As the literature review of event study methodology illustrates, the diversity of abnormal return calculation methods is vast and there is potential to refine the model to be very sophisticated. In this study the method was chosen to be a compromise of accuracy and simplicity, but it could undoubtedly be questioned is the model accurate enough. Possible refinements include adding the variables of world market model defined by Park (2004), an industry index variable and Fama-French three factor variables (1992). These changes might have lowered the overall variance of abnormal returns and the results could have given a better explanation power to the more detailed hypotheses, but this speculation remains unsolved.

The hypotheses of the business area effect and inflation effect did not get much support from the empirical analysis. For the consideration of false negative (or type II) error some details of these results are useful to analyze. The role of inflation was derived from the findings of fundamental analysis (Lev & Thiagarajan 1993). In the original study the inflation changes were significantly higher than in this thesis, ranging from 1,9 percent to 13,5 percent. Perhaps the inflation factor would have been more visible with higher fluctuation of the inflation level. One specific note from the business area

abnormal return averages is the high variance of Outotec's ELE business area. This is logical, since ELE is a collection of various technologies ranging from aluminum refining to water treatment and thus the profitability of projects can be highly varying.

The accuracy of results could have been improved by replacing the averages of companies' key figures with event time specific figures. For example in the calculation of theoretical average abnormal return per order contract the five-year average value was used, which is not very representative of all the orders because of the fluctuation over time. Presumably Outotec won more orders during general economic growth, but in the analysis the orders are presumed to be divided evenly to the five-year examination period. The inaccuracy of averages also affects the calculations based on market capitalization which was very fluctuating during the time period. For example the year-end values of market capitalization of Outotec varied from 450 million euros to 2100 million euros.

5.4. Discussion and evaluation of the research

The broad task behind the main research question was to find out if winning order contracts is regarded by investors only as "business as usual" or is every signed order contract a driver for stock price growth. The results successfully give answers to this broad question but also go deeper into the analysis of order contract reaction with additional hypotheses. The problem of analyzing the more specific hypotheses is that the effect of hypothesized variables in hypotheses 3, 4 and 5 (size, business area and inflation) is relatively low compared to other factors that are creating variance to the results. When there is only a minor abnormal return effect, a large sample would be needed to detect the effect, but in this study the sample size was relatively small, causing the possible effect of selected variables to vanish into the noise created by other variables or random movement of stock prices. This is perhaps the main reason why additional hypotheses could not bring results that would be somehow statistically significant.

The first research objective was to identify the key elements and issues of event study methodology. The aim of this objective was not to produce results that are demonstrated in results section, but to collect a compilation of methodological choices and possible pitfalls of performing event studies. From the presented research detail options the methodology of this particular study was selected only after the theory part. The second research objective was to define the general stock market reaction to order contract announcements. The general reaction is formulated into hypothesis 1. A significant stock price reaction is found and the null hypothesis is rejected. The directionality of the effect is positive as predicted, showing that investors generally value the announcements of order contracts. From the perspective of economic theories the result shows that investors do not possess all the relevant information of the order contract before the announcement, or, in other words, market efficiency in this case has the

semi-strong form. This is in line with numerous previous researches of market efficiency.

Validating the first hypothesis builds the basis for later hypotheses, which seek to achieve research objectives 2a and 2b. These research objectives aimed to detect the difference of stock reaction between the companies and the role of smaller details of order contract announcements. The second hypothesis states a difference between the stock price reaction of case companies and the null hypothesis is rejected again. This means that on company level investors can be perceived as somewhat systematical group in its reaction. That said, the sample of only two companies does not give a fully reliable picture of the situation. The higher net income percentage seems to boost the stock price reaction of order contract announcement of FLSmidth, but this can also be a mere coincidence and the result should be validated with additional companies with differing net income percentage levels.

The problems of the methodology start to arise already in the third hypothesis, where the size of order contract is hypothesized to be correlated with stock price reaction. Size is perceived to be an explanatory variable of Outotec's abnormal return variation, but most of the variance is still to be explained. For FLSmidth no correlation is found, leaving some doubt also to the results of Outotec. Plotting single observations as a scatter plot of size and abnormal return level reveals that abnormal returns are not cleanly centered on the positive side of axis, but surprisingly many observations are on the negative side. The role of outliers is also noticed to be strong. The same size of order contract could result in positive abnormal return of 4 percent or just as well, without rational explanation, negative abnormal return of 4 percent.

The fourth hypothesis expects that the stock price reaction would be affected by the operating margin of a business area where the order contract belongs to. Ideally, this hypothesis would have cleared the inconsistencies of third hypothesis, separating the outliers to different business areas and reduced coefficient of determination. However, the hypothesis fails to raise the prediction power of the model. Only statistically highly significant positive abnormal return was in the business area of minerals in FLSmidth. No correlation of business area and abnormal return level is found and null hypothesis cannot be rejected. In this point the size of subsamples are also starting to be too small for achieving generalizable results.

For the fifth hypothesis the task was to detect the minor impact to stock price reaction caused by changing inflation level. Order size was left as another explaining variable in the multiple regression analysis, because it produced significant result at least for the other company. The results of fifth hypothesis were not conclusive, but still showed quite noticeable correlation of stock price reaction and inflation. Directionality of the effect was as predicted and the value of inflation variable was approximately same in both companies. For FLSmidth the statistical test showed inflation being a significant

explaining factor of abnormal return variance, but for Outotec the result was not so clear. The promising result of fifth hypothesis still showed that even with sample size of around 100 events it is possible to detect minor explanatory variables, if they are systematical enough.

McWilliams and Siegel (1997) note how many event studies lack the details which would make the study possible to replicate. They emphasize the role of detailed and justified research methodology to create a possibility of replication. Furthermore, these characteristics are also important for the reliability and validity of a research. Saunders et al. (2009, p.156) describe those two things as the cornerstones of creating credible research findings. Reliability refers to the consistency of the research design. A reliable study would yield the same results if done on other occasion, by other researcher or observer. Transparency of the process of converting data into results is also a key factor of reliability. Validity is assessing if the result really answers the research questions and if the method is well-founded to an extent that it really measures what it is supposed to measure. From the definition we can see that reliability is a necessary condition for validity but not sufficient. An instrument can reliably produce similar results from test to test, but it does not imply that the result is necessarily right.

Concerning reliability there are various aspects in the research design aiming to improve the reliability of this research. The transparency of the data analysis process is on a high level, and the factors contributing to transparency include reporting company names and full list of event dates, describing clearly what types of events are treated as confounding events and listing the cleaned list of events, informing the source of stock data, event data, event details and inflation data, and presenting the exact form of employed abnormal return calculation formulas, including the tests of statistical significance. Following the described steps in this thesis and using the same raw data, a replication of this study would most probably yield similar results. In a quantitative research such as this, the subject or participant error and bias are minimal.

The validity of this thesis is a trickier question. Validity can be divided into internal validity, meaning the degree of well-founded causality inside the research setting, and external validity, meaning the extent to which the research can be generalized outside this particular research setting into other situations. (Saunders et al. 2009, pp.157-159) A validity problem can arise for example if the test situation changes the normal behavior of test subjects or if in the selection of test subjects the process is biased. For this particular research an important factor for validity is the theoretic foundation on which the hypotheses are built, or the construct validity. The most general hypotheses are based on rather common and shared assumptions of business theories, but when the tested variables move into smaller details such as business area and inflation one could ask if these variables are fairly chosen. For example inflation level can merely be an observable variable of various latent variables regarding macroeconomic situation, and therefore it is not indicating the phenomenon correctly. Another issue of internal

validity is the treatment of confounding events. The classification of events to confounding events is very broad when the events happen in the same company, but on the other hand confounding events from the minerals and metals processing technology industry are not checked. Outotec and FLSmidth are competitors in some business areas, so the order contract won by Outotec could possibly result in a negative reaction in the stock price of FLSmidth. This reciprocal influence to share prices might have explained some of the numerous negative abnormal returns on event day observed in both companies.

Besides internal validity, the external validity has many question marks in this thesis. The research setting is considerably case study like, consisting only of two companies that operate in a very specific industry. Thus, all the results could be argued to apply only in this industry or only to the focal companies. Even between the companies there are differences that can weaken the generalizability, for example the unique practice of FLSmidth of handling order contract rumors. A major issue for the generalizability is the representativeness of announced order contracts of the revenue of a company. For Outotec and FLSmidth the announced contracts contributed between 35 to 54 percent of total sales, so the situation can be quite different in a company where announced contracts represent for example 15 percent or 90 percent of sales. The industry of Outotec and FLSmidth is characteristic for valuable contracts that drive the business and therefore replicating all of the aspects in this study can be difficult to perform in many industries. Another aspect of generalizability is the application of the results to another period of time. This thesis applies to years 2006 to 2010 which has been a turbulent time in world economy, as the inflation figure (Figure 7) also hints. This leaves a question if the valuation of order contracts is different in times of uncertainty than in more constant circumstances.

Summarizing the issues around the cornerstones of a credible research, the possibility to reliably replicate this research is on a high level, but the interpretation of the results must be carefully done to avoid generalizing the implications too far. The small amount of companies and a very specific industry leaves the possibility to broadly generalize findings uncertain.

6. CONCLUSIONS

The implications of this thesis focus on many different levels between theoretical and practical implications which intertwine with the research objectives. The division of the implications follows roughly the classification of event studies suggested by Bowman (1983) and Henderson (1990) that is described among the research objectives. The most theoretical implications come from the methodological part of event studies. The objective was to identify key elements and issues of the methodology, and the outcome of this objective is a comprehensive description of the vast amount of event study research details. The literature review shows that there is no silver bullet for conducting a successful event study, but instead the basic research details must be chosen to meet the requirements of research objectives. One key element to be balanced is the abnormal return detection rate, which is affected by the size, homogeneity and contentual accuracy of the sample combined with the desired time window around an event. As some of the results in this thesis reveal, aiming to too specific objectives with incompatible research design ends up with highly speculative conclusions. The theoretical part of this study serves as a foundation to avoid pitfalls in future event studies. Contrasting the theoretical implications to previous literature, the message of this thesis is emphasizing the perception that event study methodology is not black-and-white but highly contingent on the overall research setting. Pre-constructed event study checklists (for example Henderson 1990; McWilliams & Siegel 1997) are a good start but they are not to be taken to the letter.

Moving slightly to more practical implications is the research objective examining market efficiency. The major question was to find out if announcing individual order contracts affects stock prices or is the valuation of order contracts deeper in the company business indicators such as the value of backlog. The significant positive reaction to order contract announcements implies that single events are contributing to the share value of the companies. An interesting follow-up question is that are investors valuing the same order contracts again when a company announces an order backlog value that deviates from forecasts. The source of the deviation could be the same orders to which investors have reacted on the moment of order contract announcement, meaning that order contracts are overemphasized. In addition, a study by Rajgopal et al. (2003) concludes that investors are overemphasizing the role of order backlog by appreciating it on top of the earnings forecasts despite the fact that order backlog is already incorporated in the earnings forecasts. Combining the results of this thesis and the results of Rajgopal et al. (2003) it would mean that a major order contract is incorporated into stock price three times: in the form of order contract announcement,

order backlog and as a part of earnings. This is against the market efficiency hypothesis because the information content should be incorporated fully in the initial moment of order contract announcement. In other words, the stock price reaction found in this research follows the market efficiency hypothesis but comparing it with other findings in the research field makes the result interestingly contradictory with market efficiency principles. A triple valuation of orders would make the whole basis of stock price skewed for companies whose business is based on high-value contracts. However, additional research is needed to conclude this possibly systematical pricing error.

Closer examination of information usefulness extends the implications of the research to the stakeholders of a company. For investors the results indicate that an investment strategy based on reacting to order contract announcements is no free lunch. Although the general reaction was found to be positive, the level of positive reaction is minimal and thus the gain of the strategy is probably eaten away by the cost of transactions. An important remark of the results is the high amount of negative abnormal returns on the event day. The negative abnormal return observations also occur independent of order contract size. This implies that investors likely have some expectations of an upcoming order contract and the announcement fails to meet these expectations. Therefore, investors must be well informed of company rumors or analyst coverage to build the right expectations to react to the announcements properly. The rejected hypotheses and the remaining abnormal return variation indicates that a plenitude of explaining variables stay unidentified. In the light of this study these variables can be systematical, contingent or purely random.

The research also includes features of metric explanation study which seeks to explain the cross-sectional variation in stock price reaction. The purpose was to find systematical reaction to the value of order contract, the business area of order contract and the inflation level, but the results are not unanimous. More conclusive evidence would create stronger managerial implications but the results nonetheless offer some insights to company investor relations. As mentioned earlier, the amount of negative abnormal return observations on event day implies that investors have some kind of prior expectations of individual contracts. If the guideline of the companies is to avoid premature information leakage about the event, the result contrarily shows that some information is leaked prior to the event. One suggestion for the companies is to analyze the negative abnormal returns one by one to find out why the negative reactions exist, for example is there signs of some rumors that overvalue forthcoming order contracts. It would be beneficial for companies to correct rumors before they escalate and affect the stock price very negatively when the actual event is announced. For the investor relation management the research results give insight on disclosure policies. Clearly, even order contracts with a value between 5 million and 10 million euros can significantly affect stock price, so disclosing small contracts is justifiable. As with the negative abnormal returns, the outliers of positive abnormal returns could be identified and analyzed, for instance to find out if the wording of order contract announcement could explain the

excess positive reaction. On the other hand, if the company has tried to emphasize the importance of a specific contract, the results show the success or failure of efficient investor communication.

The limitations of the study arise from the validity issues discussed in the evaluation of the research. Generalizability of the results can be questioned at least to other industries but even to other companies in the minerals and metals processing technology industry. Rather than giving solidly generalizable solutions to the subject, this thesis raises ideas of the stock price mechanisms of order contract announcements and tests them with the two sample companies. The exact numerical results cannot be transferred to other situations but the general directionality of the examined stock price effects is more generalizable. This study does not consider the informational content of order contract announcements qualitatively but only quantitatively, collecting some main figures from the announcements. However, the results and the appendices also enable a qualitative approach.

Regarding the qualitative research approach, a future research proposal is a case study of positive and negative outliers to get deeper into the causality of order contract announcements and stock price effects. The amount of sample companies could be broadened to cater more special cases of order announcements. Although, a challenge for this kind of study is the access to the relevant company information, meaning the possible rumors, leaked insider information and the implicit value in some order contract announcements. One very intriguing finding in the results is the pre-announcement stock price decline starting about 13 days before the announcement. The most significant stock price slump is between days -3 to -5, occurring in both companies. The explanation of this negative drift could be that investors are constantly waiting for order contract announcements to keep the business running, so no announcements means declining business. This thesis does not give any support to the cause of the decline, so the wider existence of this phenomenon is a valuable research subject. Another approach to the order contract announcement research is to reverse the research setting and examine if the order contract announcements of Outotec influence the stock price of FLSmidth or vice versa, i.e. is the competitive situation in the industry tight enough to create interdependency to the stock prices. The results of that research would also reflect to the validity of the results in this thesis, as the interdependency is not controlled.

Generally, event studies are conducted to a wide sample of companies and single companies are not relevant, but this thesis highlights the idea of using event studies to examine a single event in a limited number of companies. By singling out the reaction to a one company it is possible to define how investors consider the actions of a company compared to its competitors and thus event study methodology becomes a research tool for the area of competitive dynamics. There are still a few methodological

issues to overcome to get fully reliable results with small samples, but the subject is worth exploring those issues.

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APPENDICES (2 pieces)

APPENDIX 1: Event list of Outotec Oyj (2 pages)

			Included to event window	
Date	**Value (MEUR)**	**Technology**	**+/-1**	**+/-3**
20.4.2007	45	Grinding	x	
24.5.2007	-	Iron ore processing	x	x
20.6.2007	-	Alumina processing	x[1]	
20.6.2007	40	Chromite pellet plant	x[1]	
11.7.2007	40	Alumina calcination	x	x
14.8.2007	35	Iron ore sintering	x	x
21.8.2007	40	Metal recovery	x	x
29.8.2007	25	Zinc smelting	x[2]	
29.8.2007	30	Grinding	x[2]	
3.9.2007	75	Water treatment	x	
14.9.2007	-	Iron ore sintering	x	x
10.10.2007	80	Zinc roasting	x	
16.10.2007	30	Precious metals concentrating	x	
9.11.2007	25	Flotation	x	x
21.12.2007	30	Copper plant	x	x
26.2.2008	10	Copper smelting	x	
1.4.2008	18	Iron ore sintering	x	
7.4.2008	25	Grinding	x	
11.4.2008	29	Iron ore pelletizing	x	
30.5.2008	90	Sulfuric acid production	x	x
17.6.2008	9	Mineral processing	x	x
9.7.2008	75	Grinding	x	
12.8.2008	70	Iron ore pelletizing	x	x
9.9.2008	25	Iron ore sintering	x	
3.10.2008	175	Copper plant	x	x
11.12.2008	28	Phosphate concentrating	x	
22.12.2008	-	Oil shale plant	x	x
27.1.2009	51	Sulfuric acid production	x	
10.7.2009	110	Oil shale plant	x	x
17.9.2009	10	Copper smelting	x	
23.9.2009	7	Flash smelting	x	
6.10.2009	16	Copper plant	x	x
28.10.2009	14	Alumina refining	x	
2.12.2009	11	Copper thickening	x	x
14.12.2009	-	Flotation	x	
25.1.2010	6	Precious metals plant	x	

1.3.2010	116	Copper plant	x	
8.3.2010	119	Manganese sintering	x	x
16.4.2010	-	Iron ore pelletizing	x	x
7.5.2010	-	Furnace	x	
12.5.2010	20	Flotation	x	
6.9.2010	13	Copper smelting	x	
30.9.2010	40	Copper concentrating	x	x
19.11.2010	45	Ferrochrome production	x	x
26.11.2010	70	Water treatment	x	
21.12.2010	25	Alumina refining	x	
11.10.2006	30	Copper-zinc concentrator		
4.1.2007	-	Silver refining		
11.1.2007	-	Gold thickening		
15.1.2007	-	Zinc leaching		
17.1.2007	16	Nickel smelting		
1.2.2007	-	Flotation		
12.2.2007	-	Gas cleaning		
22.2.2007	15	Precious metals plant		
23.2.2007	-	Zinc converting		
27.4.2007	20	Gas cleaning		
25.6.2007	270	Sulfuric acid production		
27.6.2007	20	Alumina calcination		
26.7.2007	100	Alumina anode plant		
27.7.2007	15	Chromite pellet plant		
25.10.2007	20	Grinding		
26.10.2007	22	Iron ore sintering		
18.2.2008	17	Alumina processing		
19.2.2008	21	Mineral processing		
21.2.2008	25	Ferrochrome production		
21.7.2008	90	Copper plant		
3.3.2009	20	Gold thickening		
24.3.2009	15	Mineral processing		
3.2.2010	-	Iron ore sintering		
16.3.2010	15	Copper smelting		
17.5.2010	65	Copper plant		
3.8.2010	17	Chromite sintering		
5.8.2010	28	Iron ore processing		
2.9.2010	20	Iron ore sintering		

[1], [2] Combined to single event

APPENDIX 2: Event list of FLSmidth Co. A/S (3 pages)

			Event window	
Date	**Value (MEUR)**	**Technology**	**+/-1**	**+/-3**
20.2.2006	206,7	Cement production	x	x
10.3.2006	60	Cement production	x	
21.3.2006	-	Cement production	x	x
2.5.2006	50,8	Cement production	x	
6.6.2006	57	Cement production	x	x
15.6.2006	34,9	Cement kiln	x	x
22.6.2006	35	Cement production	x	x
24.8.2006	43	Cement production	x	x
7.9.2006	34,2	Cement production	x	
19.10.2006	40,2	Cement production	x	x
24.10.2006	28,6	Cement kiln	x	
30.11.2006	68,2	Ferronickel processing	x	x
14.12.2006	28	Cement production	x	x
11.1.2007	52	Cement production	x	x
23.4.2007	48	Cement production	x	
21.12.2007	139	Cement production	x	
2.1.2008	64	Cement production	x	x
9.1.2008	40	Cement production	x	x
17.1.2008	65	Cement production	x	
25.1.2008	-	Iron ore plant	x	
31.1.2008	33,6	Mineral processing	x	
14.2.2008	105,3	Iron ore plant	x	x
4.3.2008	49,3	Cement production	x	
27.5.2008	41,4	Alumina refining	x	
30.5.2008	-	Cement production	x	
4.6.2008	76	Cement production	x	
11.6.2008	63	Cement production	x	x
19.6.2008	100	Cement production	x	x
30.6.2008	158,8	Copper processing	x	
8.7.2008	95	Cement production	x	x
23.7.2008	119	Cement production	x	x
8.8.2008	28,7	Coal handling	x	
23.9.2008	30,2	Cement production	x	
30.9.2008	78,5	Cement production	x	x
15.10.2008	37,2	Ferronickel processing	x	x
31.10.2008	35,4	Copper mining	x	x
12.3.2009	40	Steel handling	x	x
31.3.2009	22,7	Cement pyro	x	x
18.6.2009	-	Cement production	x	x
9.7.2009	29,3	Alumina grinding	x	x
21.7.2009	30	Cement production	x	x
3.8.2009	13,4	Alumina calcination	x	
7.8.2009	-	Coke calcination	x	
22.9.2009	43	Cement operation	x	x

14.10.2009	130	Cement production	x	x
30.10.2009	35	Coal handling	x	x
9.11.2009	21	Cement production	x	x
24.11.2009	26,7	Coal handling	x	
30.11.2009	20	Copper mining	x	
22.12.2009	-	Cement production	x	x
14.1.2010	-	Cement kiln	x	x
22.2.2010	29,4	Mineral processing	x	
11.3.2010	154	Cement operation	x	
15.3.2010	53	Coal handling	x	
31.3.2010	23	Copper filters	x	x
9.4.2010	-	Gold production	x	x
21.4.2010	15,2	Coal handling	x	x
3.5.2010	37,1	Gold production	x	
12.5.2010	59,4	Copper production	x	
21.5.2010	107	Cement production	x[1]	
21.5.2010	65	Cement operation	x[1]	
2.6.2010	30	Gold production	x	
2.7.2010	-	Cement pyro	x	x
13.7.2010	34,6	Cement pyro	x	x
4.11.2010	28,2	Iron ore plant	x	
8.11.2010	21,6	Iron ore crushing	x	
11.11.2010	-	Cement production	x	
10.12.2010	30	Cement production	x	
10.5.2006	144	Cement production		
3.7.2006	53,2	Copper processing		
25.1.2007	90	Cement production		
29.5.2007	72	Ferronickel processing		
12.12.2007	44,2	Mineral processing		
28.2.2008	26,3	Cement mill		
13.3.2008	40	Cement production		
18.3.2008	60	Cement production		
17.4.2008	55	Cement production		
26.6.2008	-	Cement production		
27.6.2008	79,3	Cement production		
4.8.2008	30,2	Copper processing		
5.8.2008	47	Cement production		
18.9.2008	39	Mineral rolling mill		
10.11.2008	40	Cement production		
11.11.2008	49,6	Copper processing		
30.12.2008	33,9	Iron ore milling		
31.12.2008	44,4	Copper processing		
30.7.2009	55	Cement production		
31.7.2009	55	Cement production		
26.2.2010	48	Cement production		
6.5.2010	70	Phosphate handling		
7.5.2010	49,5	Copper mining		
26.5.2010	34	Cement production		

28.5.2010	32,1	Cement production
10.6.2010	36	Coal handling
5.1.2011	24,3	Cement mill
25.3.2011	95	Coal handling
29.4.2011	22,2	Gold grinding
12.5.2011	55	Cement production
31.5.2011	-	Cement production

[1] Combined to single event